OUTCOME ANALYSIS IN IPSILATERAL PROXIMAL FEMUR AND FEMORAL SHAFT FRACTURES TREATED BY INTRAMEDULLARY NAIL AND PLATE COMBINATIONS- A COMPARATIVE STUDY

Dissertation submitted to

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CERTIFICATE

This is to certify that this dissertation titled "**OUTCOME ANALYSIS IN IPSILATERAL PROXIMAL FEMUR AND FEMORAL SHAFT FRACTURES TREATED BY INTRAMEDULLARY NAIL AND PLATE COMBINATIONS- A COMPARATIVE STUDY"** is a bonafide record of work done by **Dr. SIVARAJ S** during the period of his Post graduate study from June 2014 to June 2017 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfillment of the requirement for M.S.ORTHOPAEDIC SURGERY degree Examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2017.

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DECLARATION

I declare that the dissertation entitled **"OUTCOME ANALYSIS IN IPSILATERAL PROXIMAL FEMUR AND FEMORAL SHAFT FRACTURES TREATED BY INTRAMEDULLARY NAIL AND PLATE COMBINATIONS- A COMPARATIVE STUDY"** submitted by me for the degree of M.S is the record work carried out by me during the period of **March 2016 to september 2016** under the guidance of **Prof.M.SUDHEER M.S.Ortho.,D.Ortho.,** Professor of Orthopaedics, Institute of Orthopaedics and Traumatology, Madras Medical College, Chennai. This dissertation is submitted to the Tamilnadu Dr.M.G.R. Medical University, Chennai, in partial fulfillment of the University regulations for the award of degree of M.S. ORTHOPAEDICS (BRANCH-II) examination to be held in April 2017.

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INTRODUCTION

Ipsilateral fractures of proximal femur and shaft of femur are uncommon injuries. These injuries occur in young adults sustaining high energy trauma. First description of this combined injury was given by Delaney and Street in 1953[1]. About 2.5%-5% reports have shown the incidence of this type of bifocal injury. These type of fractures impose diagnostic difficulties and complex treatment decisions. And early recognition of this type of combined injuries has become necessary to prevent the inherent disabling complications like nonunion or avascular necrosis of head of femur. Technical advances in the field of orthopaedics have made many patients to undergo definitive care of their bony injuries and also the underlying system injuries if there any [2].

A coexisting fracture of the femoral neck with shaft fracture may be overlooked because either the fragments are undisplaced or the original X-rays may not include the region of hip. Femoral neck fractures are usually difficult to detect because of external rotation of the hip or due to bar of traction splint that obscures the femoral neck from the view [1]. Various treatment options were described to treat this bifocal fracture pattern which includes 1) Antegrade femoral nailing of the shaft and cancellous screws placed anterior to the nail for fixation of neck of femur fracture.[3] 2) intramedullary nailing.[4,5](reconstruction nail, Long proximal femur nail) 3) various plate combinations including dynamic hip screw and long

side plate configuration, combination of dynamic hip screw with broad dynamic compression plate, or cancellous screws for the femoral neck and a plate for the shaft.[6]

Conventional treatment modalities include Intramedullary nail with transcervical cancellous screws[7,8], Retrograde intramedullary nailing with femoral neck cancellous screws[9], Ender's nail with percutaneous Knowles pins[10,11], combination of angled plate and compression plate fixation and Reconstruction nailing[12,13]and long proximal femur nailing. The intramedullary nail is a closed procedure and various advantages like less blood loss, less soft tissue striping, less operative time, hematoma are reported. Better union rates and decreased infection rate are significant advantages over other modalities [14].

This is a retrospective and prospective comparative study to find an **outcome analysis in ipsilateral proximal femur and femoral shaft fractures using two different treatment methods intramedullary nailing (reconstruction type / proximal femoral type) and various type of plate combinations (dynamic hip screw with long side plate/ combination of dynamic hip screw and broad dynamic compression plate fixation).**

AIM OF THE STUDY

Aim:

To study & compare the Clinical, Radiological and Functional outcome of Ipsilateral proximal femur and femoral shaft fractures treated by two methods nailing/plating in our Institute of Orthopaedics and Traumatology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai during the period of March 2016 to September 2016.

Objectives:

1. To assess and study ipsilateral proximal femur and femoral shaft fractures with special reference to fracture anatomy and stability.

2. To assess the results obtained in the treatment of these fracture with intramedullary nail or extra medullary screw plate devices and to compare the results with previously done studies.

3. To evaluate the status of this technique and method with special emphasis on:

    a. Time for union

    b. Assessment of complications

    c. Functional outcome

    d. Recovery duration after surgery

REVIEW OF LITERATURE

Ipsilateral neck and shaft fractures of femur are not common. They result from high-energy trauma mechanisms, including motor vehicle traffic accidents and falls from heights. Early ambulation is the primary goal to prevent complications associated with immobilization and to regain the patient's ability to walk. 2. Surgical stabilization of such fractures remain a challenge for all surgeons. There are three key issues regarding these bifocal fractures:

1. Optimal timing of surgery

2. Proximal femur fracture is the first to stabilize.

3. Appropriate implant to use.

HISTORY OF TREATMENT MODALITIES FOR PROXIMAL FEMUR FRACTURES FROM EARLIER -TILL DATE:

In 1902 **Hibbs** [(15)] treated proximal femur fractures conservatively in the position of flexion, abduction and external rotation stating that it improves the reduction by bringing distal fragment into alignment with proximal fragment. Initial attempts by operative intervention were made by **Delbet** in 1910.Intramedullary device with an inbuilt screw for proximal femur fractures was first introduced by **Zickel**[(16)] in

1966 and he stated that it provided excellent strength and good control of varus and rotation of proximal fragment which landed with failure in the later years.

The AO group in 1969 designed angle plate with U profile and fixed angle of 95 and 135 degrees for proximal femoral fractures which was reported with high rate of complications by various authors. Closed nailing techniques for proximal fractures started to gain importance in early 1980‘s. RUSSEL TAYLOR NAIL was introduced in late 1980s & in 1980s HALDER introduced GAMMA NAIL.

Halder S C [17] in his study on 421 patients reported that Gamma nail transmits weight closer to the calcar than Dynamic Hip Screw. However few complications including the fracture of base of greater trochanter and fractures of shaft of femur at the distal end of the nail have been reported.

A search for a new implant to overcome these adverse effects of implants lead to the development of **proximal femur nail** by AO – ASIF GROUP. It was designed in 1997 to facilitate the operative treatment of unstable proximal femur fractures. **Huber SM, Heining SM, Euler E** [18] 1997 studied the biomechanics of Proximal Femoral Nail and showed a significant reduction of distal stress and an increased stability compared with the Gamma nail. **Simmermacher RK, Bosch** [19] in 1999 in their respective studies on Proximal Femoral Nail showed a relatively low complications and low incidence of implant failure as compared to Gamma nail.

S.E Brandt S Lefever H.M.J Janzing P.L.O Broos P Pilot B.J.J Houben in june 2002 compared the percutaneous compression plating with dynamic hip screw plate for proximal hip fractures found that bone healing was same for both with advantage of blood supply and soft tissue healing in the former[20].

In 2003 **Christian Boldin et al** [21] in his study concluded that proximal Femoral Nail is a good minimally invasive implant for unstable proximal femoral fractures.

Schipper IB, Steyerborg EW et al, January 2004 studied treatment of unstable proximal femoral fractures. By comparison of gamma-nail and proximal femoral nail and found out that intraoperative blood loss was less with proximal femoral nail. Functional outcome and consolidation were equal for both implants [22].

Jeetendra Bajpai , V. K Nautiyal1 1 , Rajesh Maheshwari in 2014 suggested (cephalomedullary nail) reconstruction nail is a choice for osteoporotic and unstable trochanteric fractures, and imparts greater biomechanical stability with lesser post-operative complications[23]

HISTORY OF TREATMENT MODALITIES FOR FRACTURES SHAFT OF FEMUR FROM EARLIER TILL DATE:

Historically the management of fracture shaft of femur started before the turn of the century, with methods like splinting with wood splints wrapped with leather or fibrous plants and various fabrics encased with wax or gum.

Rush and Rush [24] in 1939 reported the use of intramedullary pins for femur shaft fracture in United States.

Professor Gerhard Kuntscher[25] in 1940 was the first to develop a device to internally fix femur shaft fractures, and in 1950 he developed the technique of medullary reaming and closed insertion of an intramedullary nail without exposing the fractures. In 1968 he proposed a new device for intramedullary fixation of comminuted femoral fractures, Detensor Nail.

In 1958 **AO/ASIF** [26] originally developed a thin walled flexible and partly slotted femoral intramedullary nail with a clover leaf cross section for these fractures.

Rokkanen et al [27] in 1969 studied his cases by comparing open or closed nailing for fracture shaft of femur and found that results were better with closed nailing.

Klemm and Schelman[28] in 1972 made the interlocking design following which in 1974, Grosse and Kempf from france invented the GK interlocking nail.

Magerl et al [29] 1979 studied plating in treatment of femoral shaft fractures which showed higher complication rates.

Aginski et al [30] 1979 describes effect of reaming and biomechanics of nailing. Reaming causes blocking of blood supply causing ischemia of fracture fragments. So he suggested that reaming should be minimum and vacuum suction along with reaming reduces blocking of blood vessels and thus reduces ischemia.

Later Clatworthy et al[31] 1998 studied effect of reaming and found that Reamed interlock intramedullary nailing united faster than unreamed nailing.

Thoresen et al [32] 1985 described excellent result with GK nailing with preference over the static mode than dynamic mode. Detailed study about this nailing was done by Wiss et al in 1986 in around 112 patients shown 98% union rate.

Brumback and Virkus 2000[33] studied that all intramedullary nailing creates some loss of endosteal blood supply and increase in intra-medullary pressure resulting in marrow embolization. They concluded that reamed intramedullary interlocking fixation remains the treatment of choice for these fractures in adults.

D.Seligson;T.Mulier et al[34] in 2006 studied about plating in the treatment of fracture femur stated that it is associated with delayed healing and indicated only in associated pelvic, spine and bifocal fractures.

Meena RC, Kundnani V, Hussain Z, 2006[35] studied closed/ open interlocking nailing and concluded that the results were comparable.

HISTORY OF TREATMENT MODALITIES FOR IPSILATERAL FRACTURES OF SHAFT AND PROXIMAL FEMUR:

In a study series of 1003 femoral shaft fractures over 8 years reported in.1965, **Dencker**[36] identified 8 bifocal fractures and indicated that associated neck fractures to be ruled out.

Steen Jensen et al [37] 1976 compared the results of plating and nailing of femoral shaft fractures. He reported that the frequency of nonunion, infection, implant failure were more in plating. Early weight bearing was possible in nailed group.

In a study conducted in Taiwan, in 1991, about femur shaft fractures **Tsai MC**, **Wu and Shih**[38] reported 42 ipsilateral hip fractures, giving a rate of 3%. The rate of incidence of bifocal fracture depended on the frequency of high energy trauma.

Wolinsky, Philip R. MD; Johnson, Kenneth D. MD[3] in September 1995 stated that the ipsilateral femoral neck and shaft fractures constitute about 2.5% to 6% of all femur fractures. The diagnosis of the neck fracture is delayed in 19% to 31 % of patients. They concluded that the goal of any treatment plan should be anatomic reduction of the neck fracture, and stable fixation of both fractures, so that the patient can be mobilized early**.**

In a meta-analysis of 659 cases of ipsilateral fractures of the hip and femoral shaft, by **Antti Alho et al** [12] in 1996, found that the median age of the patient was 34 (8-76) years. Locked intramedullary nails yielded results which were superior to combinations of plates or unlocked nails and separate hip screws. Reconstruction nails gave results equal to those of customary locked nails and separate hip screws.

Chung Hwan Chen a, Tai Bin Chen a, et al[39] in 2000 conducted a study in 18 patients with ipsilateral neck and shaft of femur fracture concluded that a plate on

the shaft and sliding hip screws or separate screws in the hip is a reliable method for ipsilateral femoral neck and shaft fractures.

In 2002, **Sudan M, Sadowski C** [(40)] in their prospective randomized study on 206 patients, compared Dynamic Hip Screw with Proximal Femoral Nail and stated the advantages of PFN nail in bifocal fractures.

T C Wong, 2004[(41)] indicated retrograde intramedullary nailing in patients with hip arthrodesis and suffer femoral shaft fracture distal to the implant in the hip

Sushrut Babhulkar, Sudhir Babhulkar[(42)] in 2005 studied that Gamma nail in treatment of ipsilateral fracture of shaft and neck of the femur is an efficient implant with the disadvantage of steep learning curve.

Hossan El Shafie et al 2000[(43)] treated nine patients with ipsilateral fractures of neck and shaft of the femur by Russell-Taylor reconstruction femoral nail. No cases of osteonecrosis or non-union of femoral neck fractures were reported.

Rajnish Garg, JL Bassi, M Yamin[(2)] in October 2006 analysed the results of bifocal femur fractures treated with reconstruction nail and stated it as a good option for undisplaced or minimally displaced fractures at hip and added a need of an experienced hands in patients with marked displacement and comminution.

R Sign,R.Rohilla,N.N.Magu et al[(44)] in august 2008 studied about the reconstruction nail and various plate combinations as two different modalities of

treatment for ipsilateral femur neck and shaft fractures found that both the methods are equally preferred with regard to its own advantages. They gave preference to stabilization of neck fracture first followed by femur shaft.

Chetan Pradhan et al in jan 2011[45] studied the use of reconstruction nails in the ipsilteral neck and shaft fractures concluded that the use of these nails provides excellent mechanical stability with predictable results and low complication rates.

Ostrum, R.F., Tornetta, P., Watson, J.T. et al[46] September 2014, published that the Ipsilateral Proximal Femur and Shaft Fractures With Hip Screws and a Reamed Retrograde Intramedullary Nail demonstrated a high likelihood of union for the femoral neck fractures and a low risk of malunion. Comminution and initial displacement of the proximal femoral fracture still lead to a small incidence of malunion or nonunion, and open comminuted femoral shaft fractures still may progress to nonunion despite appropriate surgical management.

Bikash Jyoti Bordoloi, Sukalyan Dey et al [47] in September 2015 studied the usage of proximal femur nailing for ipsilateral neck and shaft femur fracture concluded the combination of interlocked intramedullary nailing with twin cephalomedullary screws in form of PFN nail has become the promising modality as a versatile implant in these fractures with high success rate.

A Agarwal, SP Gupta et al[48] in the year 2016 march published a paper about treatment modality for ipsilateral neck and shaft femur fracture, stated that compared to broad dynamic compression plate, reconstruction nail with cancellous screws forms best modality with better outcome.(last but not least)

WM Gadegone, Vijayanand Lokhande et al [49]in Jan 2016 concluded that LPFN gives better functional outcome as a single implant in these fractures.

DELAYED DIAGNOSIS OF THE HIP FRACTURE:

Femoral neck fractures are often missed in the diagnosis of bifocal fractures as they are either undisplaced / minimally displaced or the region may not be included in the original X-ray. **Delaney WM** in 1953 found that external rotation or the hip splint may hide the view of neck leading to delayed diagnosis of the condition [1]

Denker in 1965 suggested by a study that the rate of late diagnosis found to be less in hospitals where the hip region is also included in fracture shaft of femur [36].

Swiontkowski et al [50] in 1984 reported 3 of 15 cases in their study were found to be delayed in neck fracture diagnosis, out of which two cases were diagnosed only after operative fixation of shaft fracture. **Bucholz RN et al** [51] in 1985 quoted the incidence of delayed diagnosis to be 19-31% during their initial presentation. **Riemer et al** in 1993 mentioned that the undisplaced fractures of femur neck were the reason for missed diagnosis. **Bennett et al** [52] in 1993 during their study found

the neck fractures of about 20%-30% were missed in the initial presentation of the condition leading to the delay in their treatment but no one went for nonunion. Thus by their study they concluded that no complication would be associated with the delay in diagnosis of neck fracture. Some non-unions may occur due to missed diagnosis during their initial care and it necessitate the need for later operation. [53]

COMPLICATIONS IN IPSILATERAL BIFOCAL FRACTURES:

There are many complications in bifocal fractures which depends on the mode of injury, associated injuries and the treatment modalities. The major complications include non-union, osteonecrosis, mal-union and delayed union.

Osteonecrosis can be found only if the patient is followed up minimally for more than 2 years. **Swiontowski et al** [50] in 1984 reported the incidence of osteonecrosis to be 22% after the follow up for 3 years. **Wiss**[9] and his co-workers in 1993 reported 6% after 2and ½ years of follow up. Followed him **Alho**[12] in 1996 reported the incidence to be 6% in his study after 2 years of follow up.

The incidence of **nonunion** was found to be 18% in the study by **Wiss DA** [9] et al. **Ranjinish garg et al** [2] in 2006 and recently in 2011 **Chetan Pradhan et al** [45] found the incidence of the same to be 4% in his study.

Revision surgeries in such cases provide good functional outcome. **Delayed union** was found in most of the cases with associated soft tissue injury. In

these cases significant blood loss to the site of fracture took longer time of revascularization and there by the healing time. **Ranjinish garg**[(2)] in 2006 and **Chetan Pradhan** in 2011 found the incidence to be 8%.

Malunion is the rare complication among all these. Higher the velocity of injury more the complications would be. Minimally displaced fractures and associated complications can be treated easily where as in displaced and comminuted cases it needs an experienced hand to avoid devastating complications.

TECHNIQUES OF TREATMENT:

Treatment modalities have changed from simple conservative to operative treatment. Need for the best modality of treatment to prevent complications in bifocal fractures had lead to the evolution of various techniques.

1) Closed Treatment:

In 1976 **Mackenzie** reported close treatment in the form of skeletal traction through tibial tubercle but more complications were associated with this. Since 1979, these conservative series of treatment had not been reported in any study [(54)].

2) **Ender's nail: Casey and Chapman** [(55)] in 1979 tried to treat the ipsilateral fractures using Enders nail with supplementary supportive pins at the neck of femur. This modality resulted in complications like mal-union and nonunion which led to withdraw this.

3) **Screw fixation of the hip combined with plate fixation of the shaft:** This combined screw and plate were widely used in the past [52,57].The advantages of this include that it forms the reliable and familiar methods of fixation for each fracture. The disadvantages include increased blood loss and periosteal stripping of the femoral shaft, extensive surgical dissection, with potential need for bone graft.

4) **Intramedullary nailing of the femoral shaft and combined with screw fixation of the femoral neck:** To overcome these disadvantages **Oh et al** [56] and **Abalo A et al** [57] did a study using retrograde nailing for shaft fractures and cancellous screws with DHS plate for neck fractures and found favorable results.

Bucholz and Rathjen et al [58] in 2001 reported this combination of combined pinning and nailing. They suggested that screws should be inserted behind or in front of the nail, and in a more or less parallel fashion. Also found locked nailing yielded better results than unlocked nailing

5) **Closed nailing with supplemental screw technique:** Closed reamed antegrade IM nailing with supplemental screw fixation of ipsilateral bifocal femur fractures produced high range of varus malunion for femur neck fractures leading to unsuccessful results[9].

6) **Reconstruction nail:** Newer type reconstruction nails evolved then for the simultaneous fixation of femur neck and shaft fractures with minimal exposure.

They provide wide range of advantages over the other in less soft tissue dissection and blood loss, better cosmetic appearance, thereby shorter hospital stay[59]

The newer types [60,61] include gamma nail, russel taylor nail, cephalomedullary nail and long PFN. Among these former two reported high rate of complications and the latter two provide sufficient strength and also been used more common.

Russel and Taylor nail: The reconstruction nail by Russel and Taylor was designed with two goals for treating femur fractures. The first goal was to overcome the complications produced by the previously available nails. The second goal was to provide more acceptable technique in the management of bifocal femur fractures [13].

Kao et al [62] treated 15 ipsilateral femoral neck and shaft fractures over a period of six years from 1999 to 2005 with the Russel Taylor reconstruction nail. The union rates for neck and shaft fractures were 100 and 84% respectively. They concluded that reconstruction nails as an alternative acceptable treatment options.

Bose et al [63] reported high complication rate after Russel Taylor reconstruction nails. In their series there found complications like delayed union, shortening of the femur, mal-alignment

Gamma nail: In 1990, Halder introduced Gamma nail. **Halder S C** [17] in his study on 421 patients reported that Gamma nail transmits weight closer to the calcar

femorale than Dynamic Hip Screw. However few complications including the fracture of base of greater trochanter and fractures of shaft of femur at the distal end of the nail have been reported**.** The Gamma nail is the best implant in treating these fractures but the result were unsuccessful in Indian set up compared to western countries. There is always a risk of complication by the use of oversized reaming and anterior thigh pain [(64)].The single screw placement for the stabilization of the trochanter and neck gives rise to the increased incidence of superior migration of the nail and subsequent varus collapse.

Reconstruction or cephalomedullary nail:

Shetty et al treated ipsilateral femoral neck and shaft fractures over a period of ten years from 1995 to 2005 using cephalomedullary nail. Using the Friedman and Wyman score, they reported good outcome in 79% and poor in 9%. They also found complications associated with soft tissue dissection was minimal in these cases post operatively and thereby possibility of early mobilization**.** [(5)]

Watson JT and Moed BR in 2002 Jun studied about the complications of these fractures and their treatment. Lag screw fixation of the femoral neck fracture and reamed intramedullary nailing for shaft fracture stabilization found to be associated with the less complications. In 2006, **Garg et al** reported a study of treating 25 patients of ipsilateral hip fracture and shaft of femur using reconstruction nail from

1996-2003 with minimum follow up of one year along with critical analysis of intraoperative complications. They concluded that reconstruction nail was a good implant for undisplaced or minimally displaced fractures at hip. But with marked displacement and communition at hip fracture site, the reconstruction nail results were good only in experienced hands [65]

In 2011, **Tsarous et al** reported bifocal ipsilateral femoral fractures of 11 cases with reconstruction nail over a period of 4 years from 2004 to 2008. The mean union time was 4 months for the neck fracture and 8 months for the shaft fracture. Complication was also very minimal [66].

In February 2012, **Khan et al** reported ipsilateral fractures of the neck and shaft of femur using reconstruction nail from 2005 to 2011 in about 38 patients. Outcome was analyzed using the Freidman and Wyman system and reported good outcome in 87%.They concluded that reconstruction nail is an effective in fixing both fractures simultaneously without compromising fracture healing**.** **[67]**

A closed technique can minimize bleeding; wound complications are less but several disadvantages in reconstruction nailing have been reported by **Tsai et al** in 2009.The procedure is technically demanding. Nail insertion may cause further displacement of the femoral neck fracture, which then becomes difficult to reduce. [68]

Long PFN nail: (Proximal femur nail) The LPFN is available in 130‑135° and has a 6° proximal medio-lateral angle to facilitate easy insertion from the trochanter. The nail and screw support proximal head/ neck fragment. LPFN allows the temporarily mechanically incompetent but biologically viable fragments to heal around the nail. IM implant itself acts as a buttress to prevent excessive fracture collapse and shaft medialization. Long PFN rigidly stabilizes both the factures adequately leading to osseous healing. It also offers the advantage of a reamed and unreamed implantation technique, high rotational stability of the head‑neck fragment, and the possibility of static or dynamic distal locking. Almost all the load is transferred to the nail and negligible portion to the medial femoral cortex [(49)] **Bikash Jyoti Bordoloi, Sukalyan Dey et al** in Sep 2015 studied the usage of proximal femur nailing for ipsilateral neck and shaft femur fracture concluded that the combination of interlocked intramedullary nailing with twin cephalomedullary screws in form of PFN nail has become the promising modality as a versatile implant in these fractures with high success rate [(47)]

PLATE COMBINATIONS:

Treatment modality for these fractures using plate with dynamic hip screws found to be easier by technical wise. The advantage being, it is a reliable and familiar technique. But due to its disadvantages and complications it is consider inferior than nailing [(9)].

Hung SH et al[69] in 2004 published their results of ipsilateral fracture neck with shaft (group 1) and intertrochanteric fracture with shaft (group 2), a comparative study during the year 1982-1998 with four and half years follow up. Patients were treated with plate for shaft fractures and DHS for proximal fractures. They found better results in group 1 than group 2 with minimal complications.

Abalo et al in 2008[57] published their study about surgical outcomes of ipsilateral femur neck and shaft fractures after a detailed study between 1997 and 2004 with 4 years of follow up concluded that the use of DHS and compression plates for ipsilateral fractures is reliable to achieve bone union with few complications.

Wang WY et al[70] in 2010 reported a comparative study with PFN or various plate combinations for these fractures between 2004-2008 with two years follow up concluded both treatment modalities yielded satisfactory outcomes.

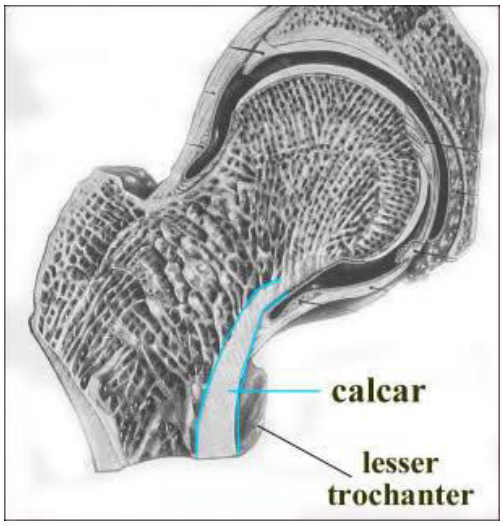
Kesemenli CC et al [71] in 2012 reported by their comparative study of nailing/ plate combinations for ipsilateral fractures found that the nailing provide better functional stability, increased rate of union and complications than plating.

Kashayi- Chowdoji Rao et al [72] in 2016 published a study about analysis of nailing versus plating for ipsilateral femur neck and shaft fractures concluded that these bifocal fractures can be treated satisfactorily with both methods with similar outcome.

APPLIED ANATOMY

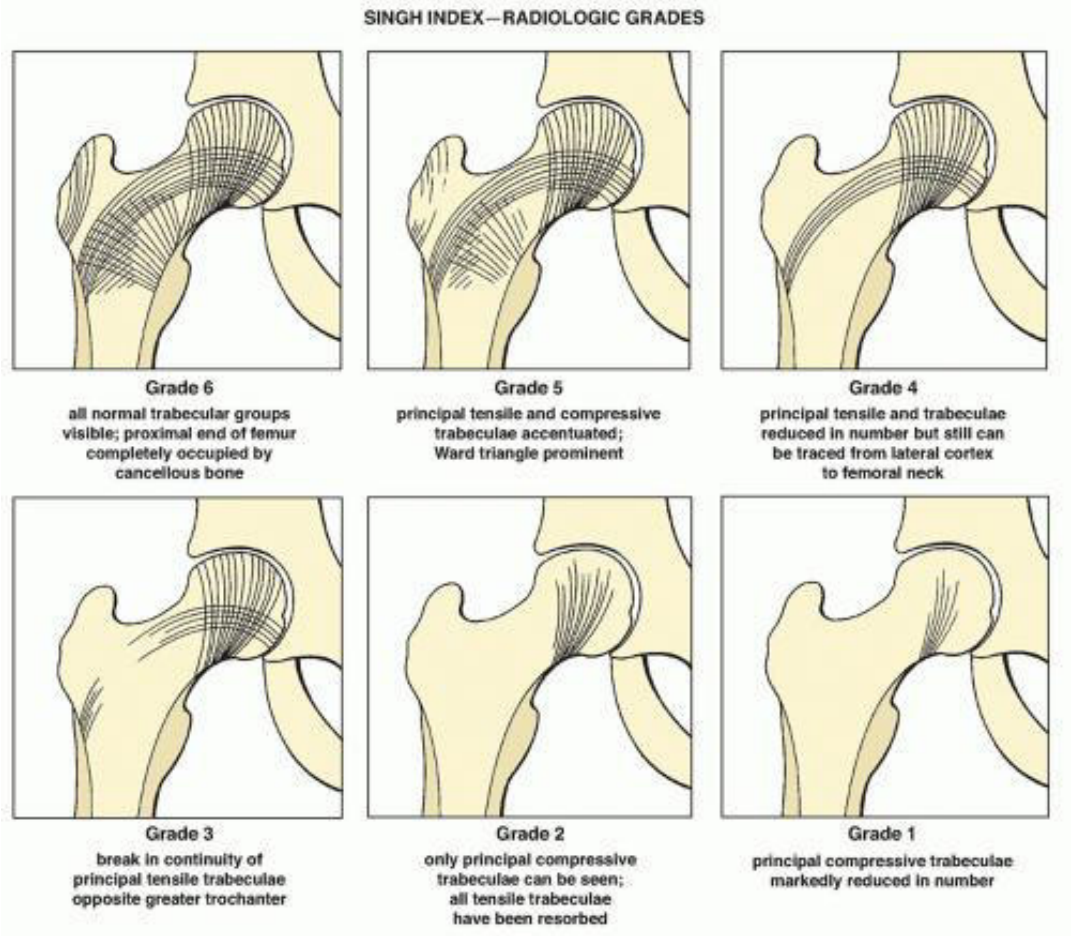
Proximal femur

The head of femur is not a sphere exactly. The hip joint is congruent only in the weight-bearing position. The internal trabecular system of the femur head was described by ward in 1838. The orientation of trabecular is along lines of stress, thicker and dense lines is present in the calcar; the calcar is thicker medially, gradually thinning out as it passes laterally. They rise superiorly into weight-bearing dome of the femoral head.



CALCAR FEMORALE

Forces acting along trabecular lines are largely compressive. This knowledge is essential to rule out osteoporosis. The ability to hold an internal fixation device is poor in osteoporotic bone. Singh's index describes trabecular pattern present in femur head. It is graded through 1-6 based on the disappearance of these patterns on x-ray. Singh index less than 3 is associated with hip fractures.



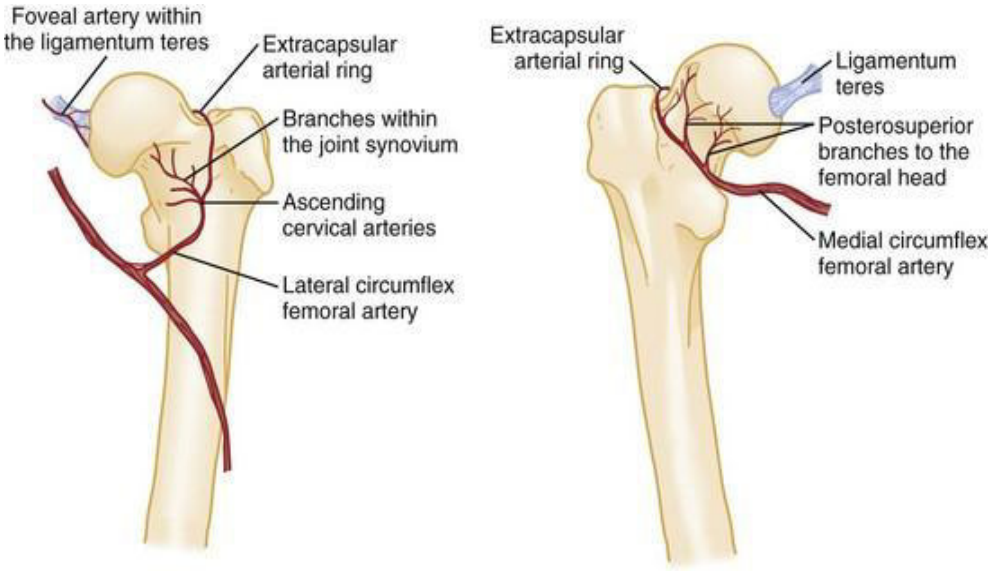
SINGHS INDEX:

VASCULAR ANATOMY: Crook [73] described the arterial supply of head and neck of femur in three groups:

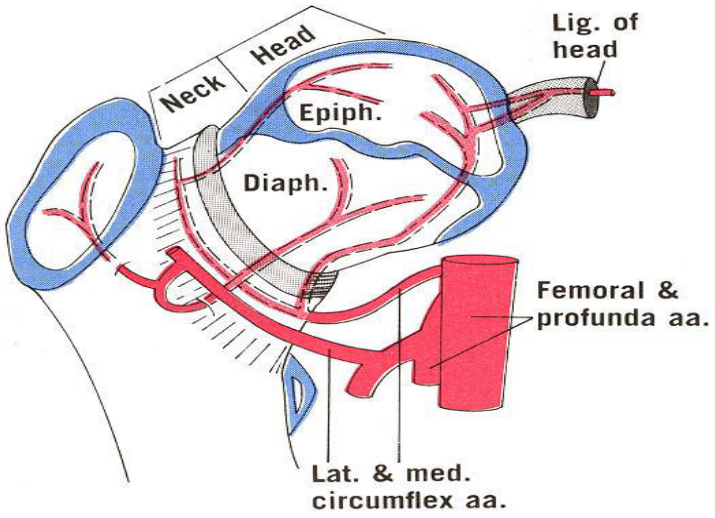
(a) An extra-capsular arterial ring present at the base of the femoral neck

(b) Ascending cervical branches of the extra-capsular arterial ring-located on the surface of the femoral neck and

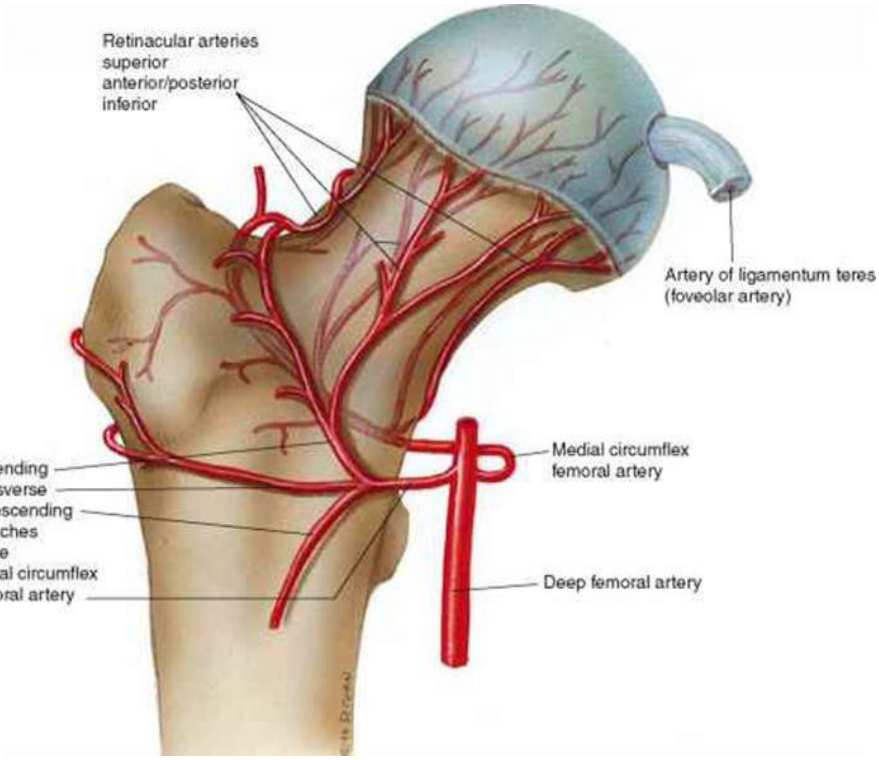
(c) The artery of the ligamentum teres



Extra-capsular arterial ring: Formed posteriorily by a large branch of the medial femoral circumflex artery. Anteriorily by branches of the lateral femoral circumflex artery. Minor contributions: from superior and inferior gluteal arteries.



From the Extra-capsular arterial ring gives rise to the ascending cervical branches called as retinacular arteries (described initially by Weitbrecht).



In any femoral neck fracture, the proximity of the ascending cervical arteries to neck renders them at risk for injury. Because of good and adequate vascular supply to the metaphysis, there are no osteonecrosis changes in the neck as compared to the femoral head[74].

The ascending cervical arteries can be divided into four groups, anterior, lateral, posterior, and medial based on their relationship to the neck of femur. Most of the blood supply to the femoral neck and head is from the lateral group. At the junction of neck of femur and the margin of the articular cartilage, these vessels form a second ring, described by **Chung**[74] as the **sub-synovial intra-articular and intra-capsular arterial ring**. Epiphyseal and metaphyseal arterial branches arise from the sub-synovial intra-articular ring and enter the head of femur.

Claffey [75] has demonstrated that osteonecrosis occurs in all neck of femur fractures that communicate with the point of entry of the lateral epiphyseal vessels.

Trueta and Harrison [76] reported that the femoral epiphyseal blood supply in adults arises largely from the lateral epiphyseal arteries supplying lateral 1/3 and central part of femoral head. Both these arteries anastomose at the junction of central and medial 1/3 of head.

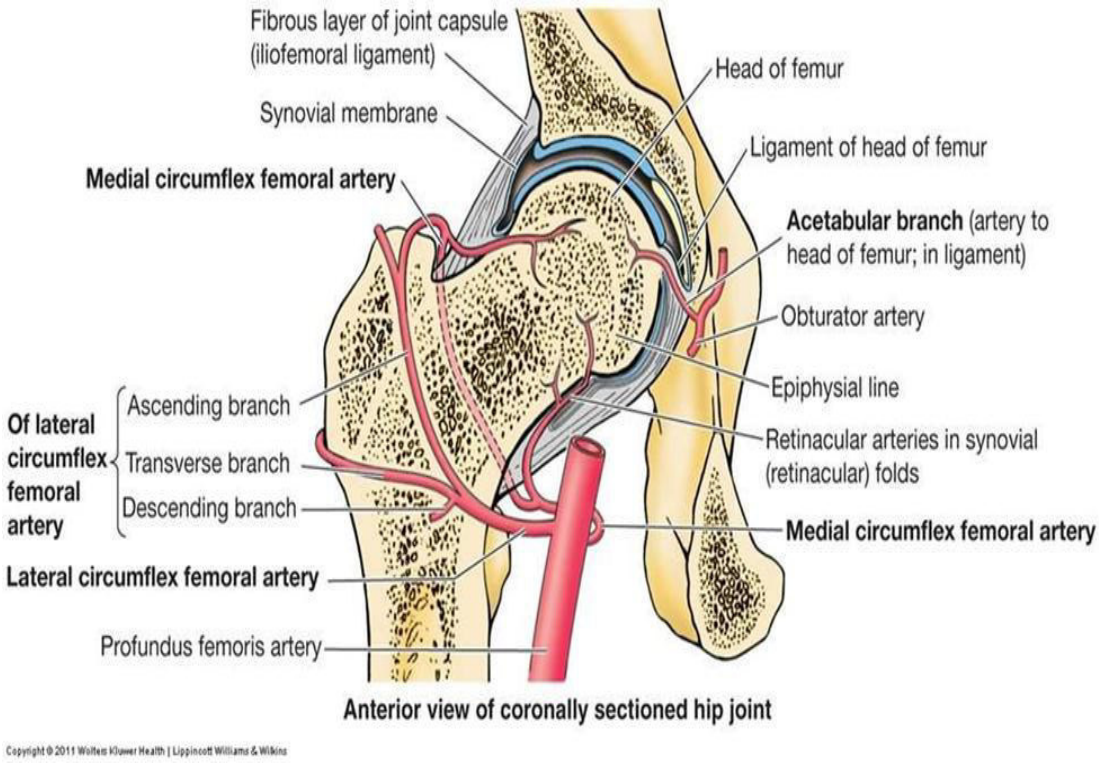
CLINICAL SIGNIFICANCE OF VASCULAR ANATOMY: Femoral head circulation arises from three sources:

1) Intra-osseous vessels which cross the marrow spaces from below

2) The artery of the ligamentum teres (arise from obturator artery)

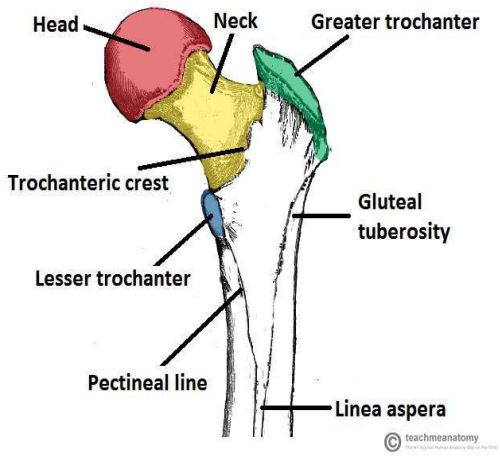
3) The retinacular vessels runs along the femoral neck beneath the synovial reflection. In femur neck fractures these intra-osseous vessels get disrupted thereby major supply would be from these arteries in case of undisplaced fractures.

Howe et al [77] found that the vessels of the ligamentum teres supply the medial 1/3 of femoral head, but they are inadequate in repacing major vascularity of the femoral head, after a displaced femoral neck fracture. Thus prompt reduction and stable fixation in femoral neck fractures is necessary.

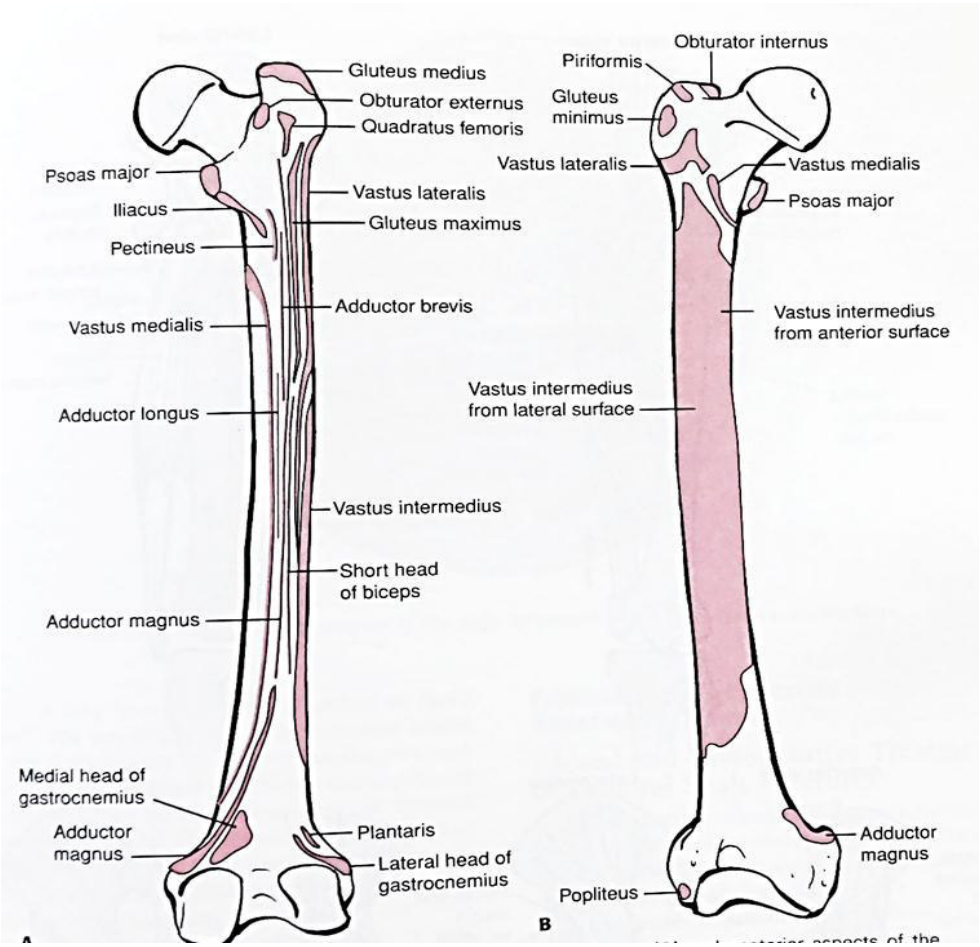


APPLIED ANATOMY OF THE FEMORAL SHAFT

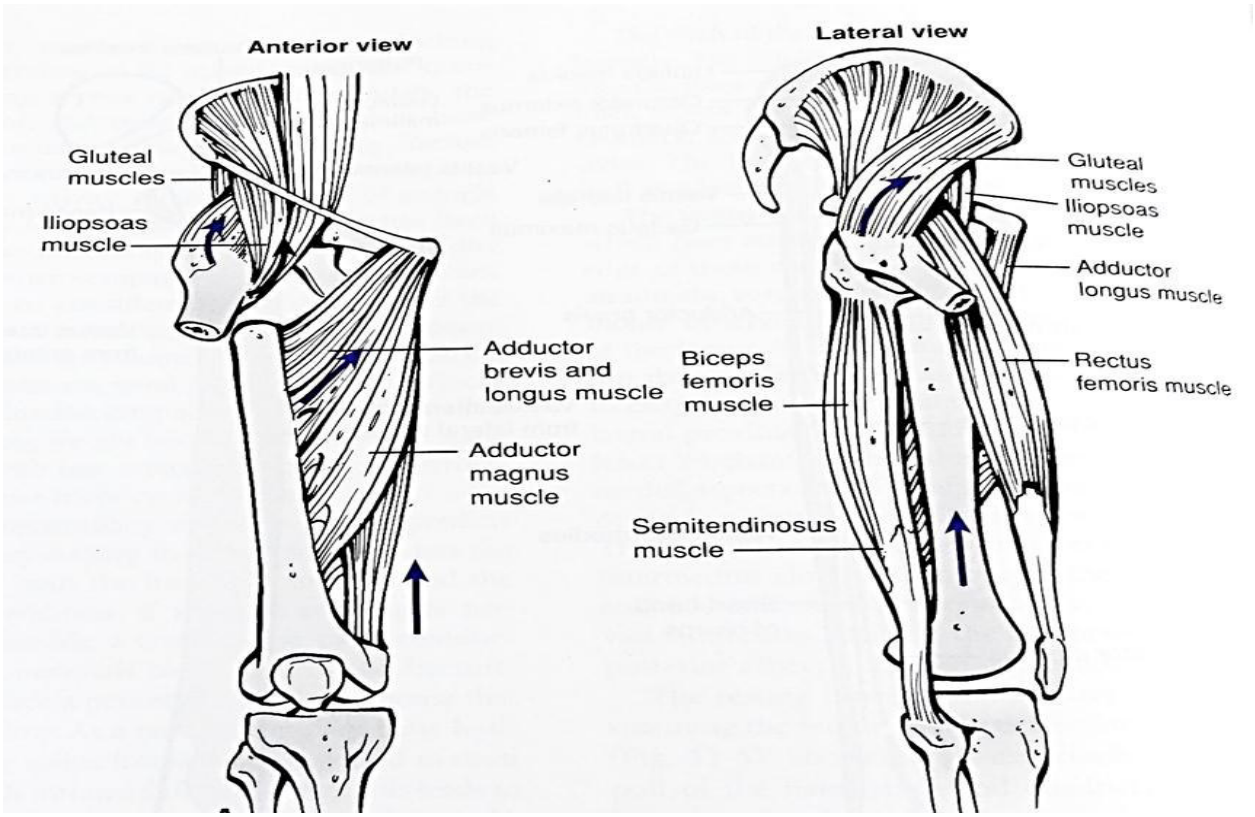
The femur is a tubular bone and is the longest bone in the human body. The femur has a 120 cm anterior-radius of curvature. The femoral shaft is cylindrical medially, anteriorly and laterally. The thickened posterior cortex of the femoral shaft merges into the linea aspera in the center. The linea aspera serves as a muscle attachment site as well as a buttress along the concavity of the diaphysis of femur. The femur is almost completely surrounded by muscles. Most of the muscles have attachments to the femur itself. Knowing these muscle attachments is important and helps to perform surgical dissections. It helps to understand the deformity patterns associated with fracture.

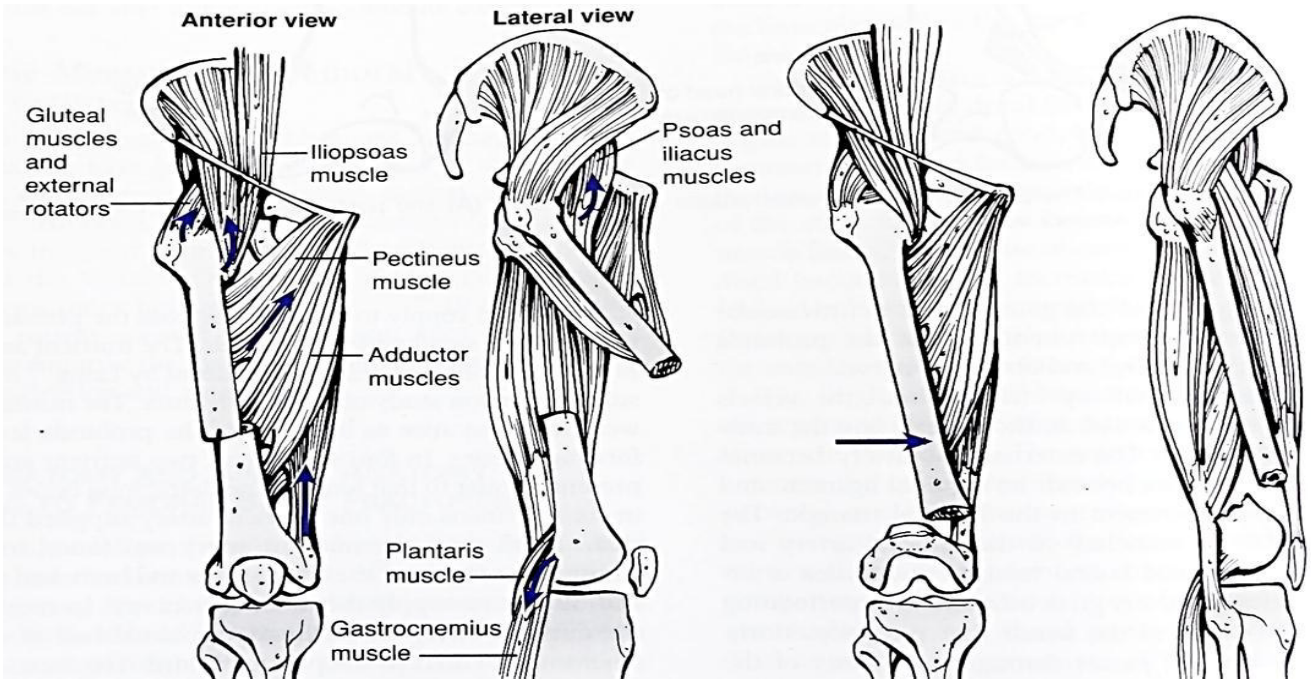


LINEA ASPERA:



MUSCLE ATTATCHMENTS IN FEMUR

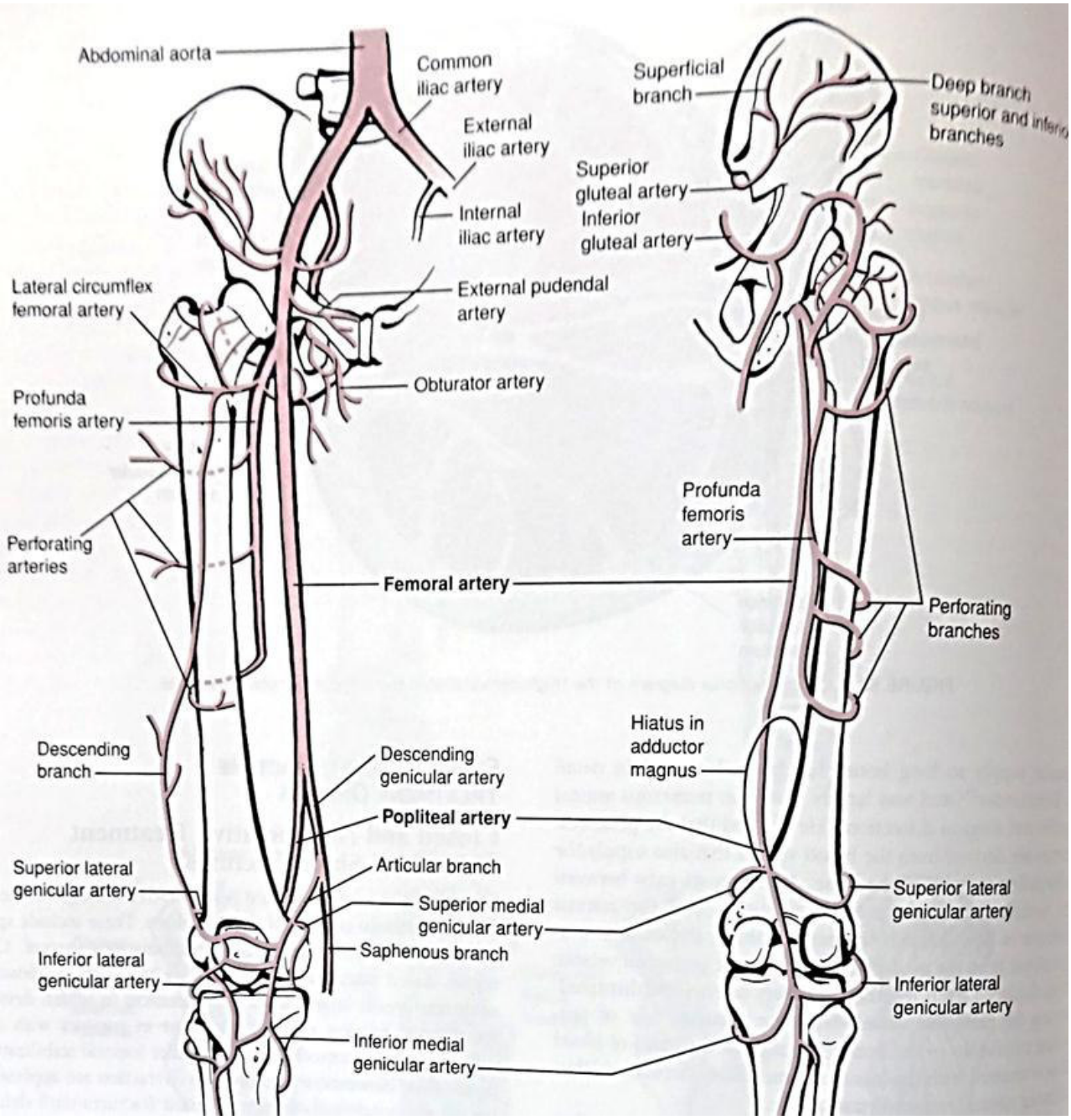




Deformities and displacements are determined by the muscle attatchments and fracture location.

VASCULAR ANATOMY OF THE THIGH:

The vascular anatomy of thigh includes both the vessels passing through the thigh as well as those supplying the muscles and bone. The external iliac continous as femoral artery which supplies the entire femur.



Knowledge of the location of these vessels helps make surgical approaches safer.The blood supply of femur is mainly from the primary nutrient vessel and small periosteal vessels.

The **nutrient arterial** supply to the femur was described in detail by Laing[78] in a barium sulfate injection study of 10 adult femurs. The nutrient arteries were found to arise as branches of the perforating branches of profunda femoris. The nutrient artery enter the femur in the region of the linea aspera. It supplies the medullary cavity either in the proximal half of the femur; often in the proximal third. The location of entry for this vessel has implications during surgical approaches. The linea aspera should not be stripped of its muscular attachments to preserve this nutrient vessel.

The **periosteal vascular** supply to long bones has been described in detail by Rhinelander[79]; largely based on numerous animal studies and surgical dissections. He showed that the periosteal arteries are derived from the blood supply of surrounding muscles. Anastomoses exist between the medullary and periosteal circulations, uni- directional from the medullary vessels to the periosteal vessels. With displaced fractures, the medullary arteries are disrupted, leaving the periosteal vessels with the principle role of providing circulation to the bone. The normal direction of blood flow is reversed with the loss of the medullary circulation, thus allowing cortical revascularization.

MECHANISM OF INJURY

The ipsilateral fractures of femur shaft and neck are commonly associated with high energy trauma like fall from height, fall down closely followed by road traffic accidents and industrial accidents. **Chetan Prathan et al** in his study mentioned that the mechanism of injury in 44 patients was Road Traffic Accident while 6 patients had history of fall from height.[45] **Dr. Parag Tank et al** in 2015 reported that Fall Down closely followed by Road traffic accident as the most common cause of injury in his study[80].

Shuler TE et al in 1997 suggested that young males are affected in such injuries in high proportion as it occurs due to an axially directed force along the flexed femur, seen in a dash-board injury [81].

The mechanism of injury is thought to be compression of the femur against acetabular roof with the hip in flexion and abduction. Patients sustain high energy impaction as in case of dash board injury with the hip in abduction [53,59]. As a result force moves in the direction of femur proximally toward the neck of femur, femoral head, which in such a situation is well contained in the acetabulum, the entire thrust is borne by the femoral shaft and the residual force is responsible for the proximal femoral fracture. The low incidence of neck nonunion and

osteonecrosis of the femoral head in this bifocal femoral fracture is because of the same.

The outcome of this bifocal fractures mainly based on the result of treatment of the femoral shaft fracture. Because most of the neck fractures are undisplaced and often heals fast. Severe the shaft injury, higher is the incidence of nonunion rate. Therefore careful management of shaft fractures and postoperative protected weight bearing are very crucial in management of these fractures [1,54].

Boyd in 1961 mentioned that the direction of force, position of the patient and strength of the bone determines pattern of injury. He found in his study that for the same reasons, intracapsular fractures were more common than the extracapsular variety (2.1:1) and relatively low injury produced severe disability in osteoporotic patient because of their inability to recover [82].

ASSOCIATED INJURIES:

The associated injuries reported in these high velocity fractures were head injuries, chest injuries, abdominal injuries, knee injuries, upper and lower limb injuries in ipsilteral and contralateral side [12].

Boyd in 1961 mentioned, though the incidence of associated fractures given in previous English literature was 25%, he found only 15% cases with associated fractures of patella or knee injury in his study [82].

Swionotski in 1987 reported that the ipsilateral knee injuries were common causing significant morbidity and stated their incidence between 20 and 40% [50]

In 1993 Winquist RA et al and Bennett FS et al stated that the associated injuries are often noticed when the patient kept the knee in the attitude of flexion at the time of injury [83,52].

Recently Chetan Pradhan et al [45] in 2011 mentioned that the mechanism of fractures shaft of the femur sustained in automobile accidents involves the knee or distal thigh striking the dashboard and may be combined with other injuries of the same extremity or of the pelvis.

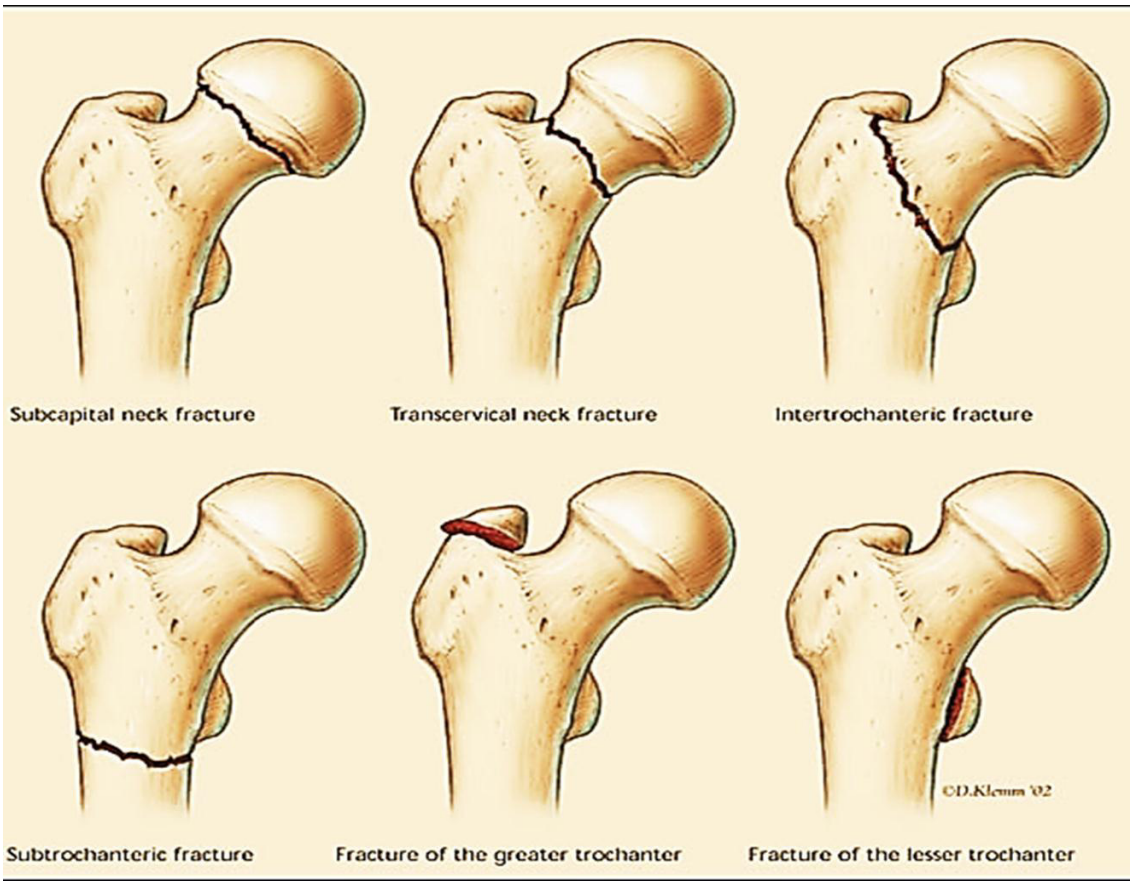
Dr. Parag Tank[80] in 2015 in his study mentioned that as a whole 22.5% of the patients had associated injuries in which 17.5 % of patients had injury in form of distal end radius and calcaneum fractures and 5% of the patients had other system injuries both of them had head injuries. Right extremity was more involved in our study.

FRACTURE CLASSIFICATION

TYPES OF PROXIMAL FEMUR FRACTURES

Based on anatomical location:

Intracapsular	Extracapsular
Subcapital	Basicervical
Transcervical	Intertrochanteric
	subtrochanteric

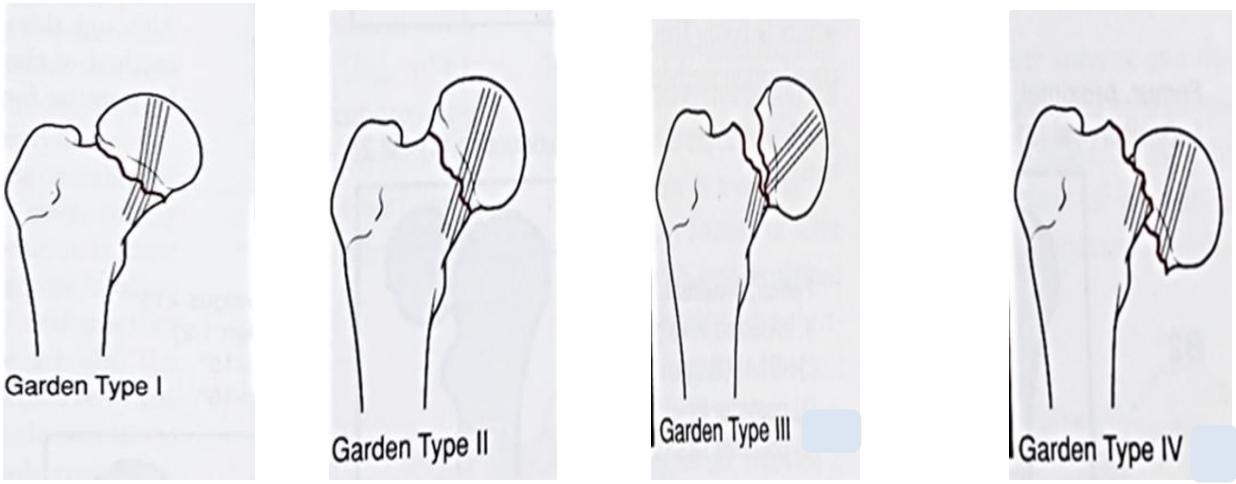


Garden classified neck fractures (based on AP radiographs on fracture displacement):

Type I: Incomplete(valgus impacted) or impacted fracture. The trabeculae of the inferior neck are still intact.

Type II: Complete and non displaced. The weight-bearing trabeculae are interrupted by a fracture line which runs across the entire neck of the femur.

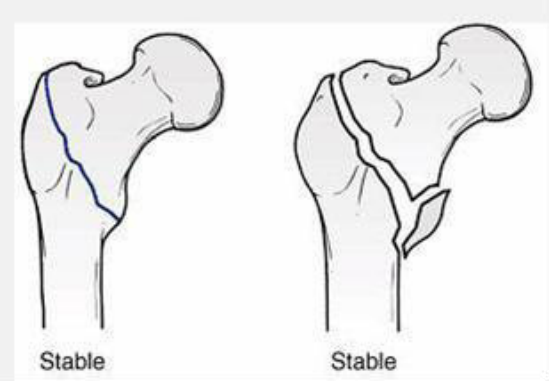
Type III: Complete but partially displaced. The retinaculum of Weitbrecht remains attached and thus maintains continuity between the proximal and distal fragments. The femoral head trabecular pattern does not line up with that of the acetabulum.



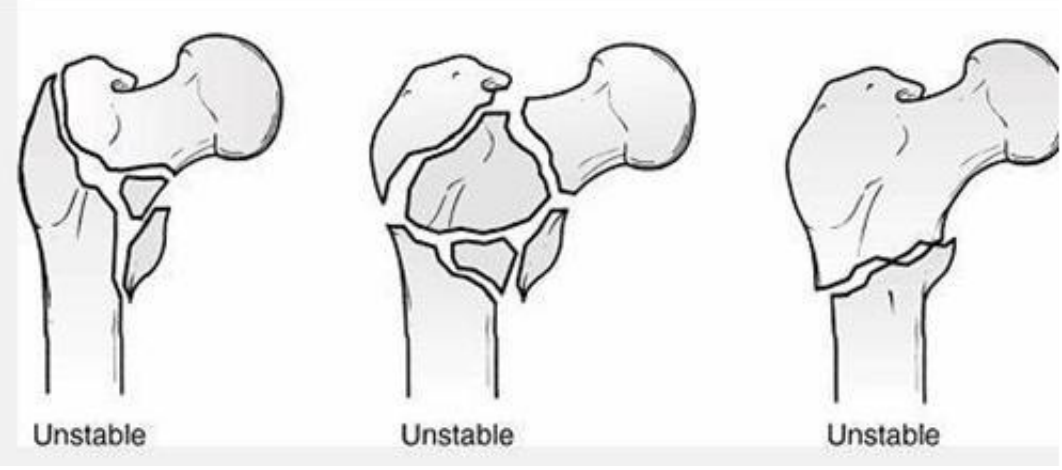
Type IV: Complete and fully displaced. All continuity between the proximal and distal fragments is disrupted. The femoral head assumes its normal relationship in the acetabulum. Trabecular pattern of the femoral head line up with the acetabular trabecular pattern.

EVANS CLASSIFICATION OF INTERTROCHANTERIC FRACTURES

Stable fracture patterns: The posteromedial cortex remains intact or has minimal comminution. It is possible to obtain a stable reduction



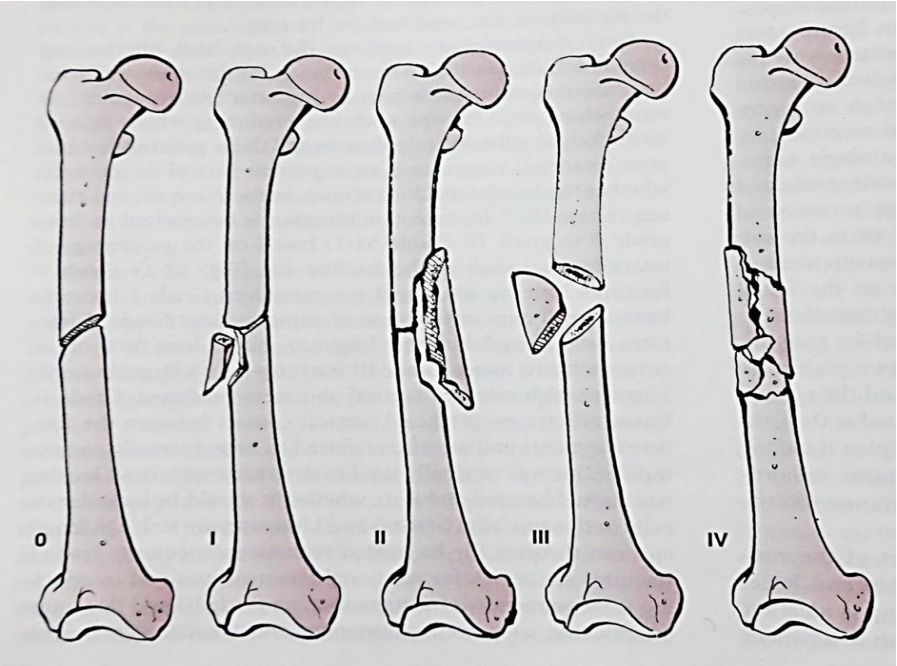
Unstable fracture patterns: characterized by greater comminution of the posteromedial cortex



The reverse obliquity pattern is inherently unstable. This is because of the femoral shaft tendency for medial displacement.

Winquist and Hansen classification [84]:

This is the most widely accepted classification. It divides the diaphyseal fractures into five grades based on comminution.



Grade 0: Not associated with any comminution.

Grade I A comminuted fracture in which a small piece of bone has broken off not affecting the fracture stability

Grade II A comminuted fracture in which at least 50% contact of abutting cortices

Grade III. A comminuted fracture which has less than 50% cortical contact

Grade IV. A comminuted fracture which has lost circumferential buttress of bone and no fixed contact between the two major proximal and distal fragments

TYPES OF FEMUR SHAFT FRACTURES:

AO / ASIF classification: (Association for the study of internal fixation)

Simple fracture (the degree of obliquity of the fracture line)

Al - Simple spiral

A2 - Simple Oblique (300 or more)

A3 - Simple transverse

Wedge fractures (the anatomy of the wedge fracture.)

B1 -Spiral wedge

B2 - Bending wedge (FLEXION)

B3 - Fragmented wedge

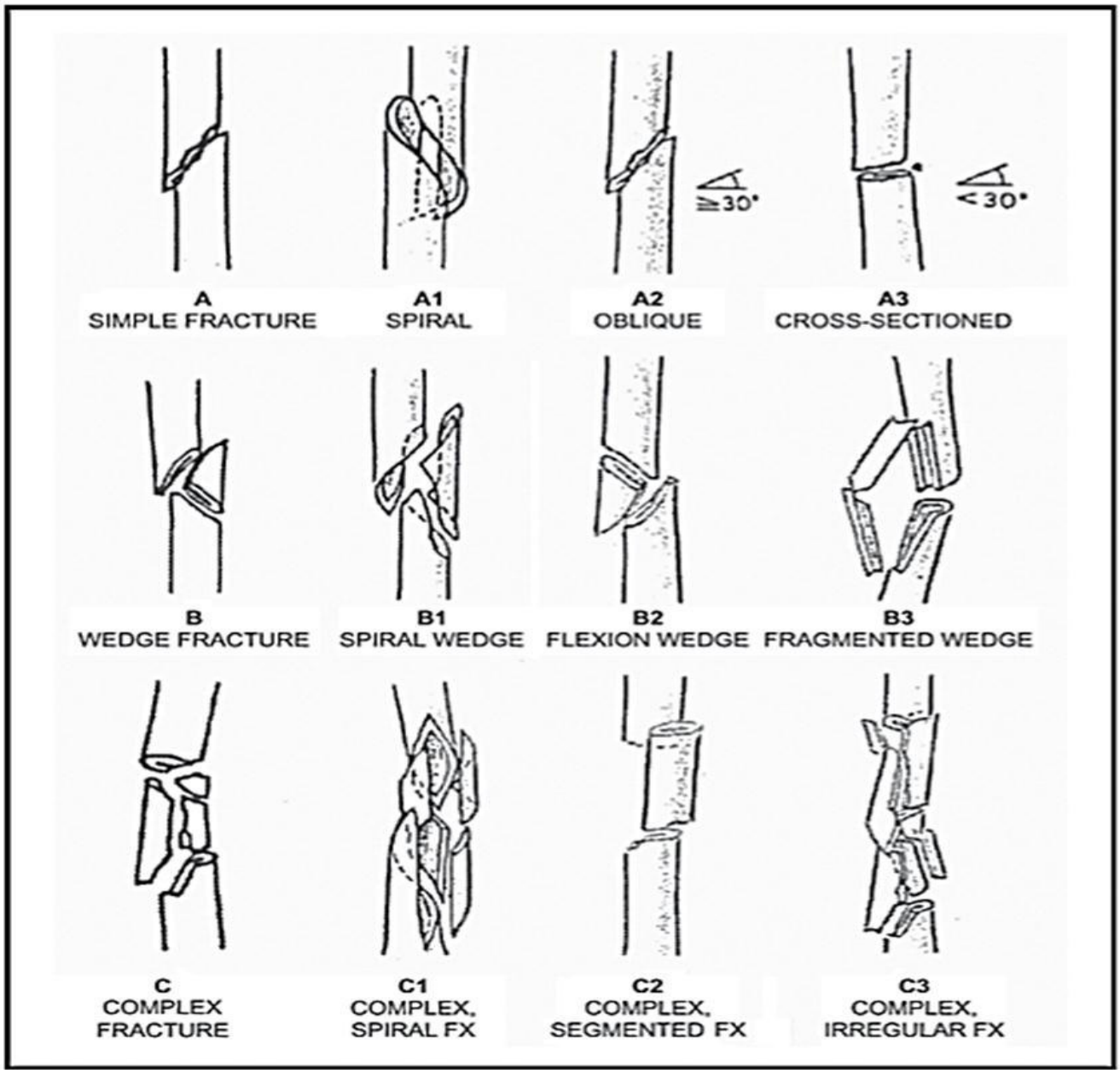
Complex fractures

C1 –Complex Spiral

i) With 2 intermediate fragments

ii) With 3 intermediate fragments

iii) With >3 intermediate fragments



C2 – Complex segmental

i) With 1 intermediate segment

ii) With 1 intermediate segment and an additional wedge fracture

iii) With 2 intermediate segments

C3 – Complex irregular

i) With 2 or 3 intermediate fragments

ii) With shattering limited to <5cm length of bone

iii) With shattering >5

Depending on geometry of fracture line [85]

1) Transverse < 30deg
2) Oblique > 30deg
3) Spiral Segmental
4) Wedge
5) Butterfly fragment
6) Comminuted

Based on anatomic location:

1) proximal third
2) middle third
3) Distal third in location, or at the junctions between these

Based on the location relative to the isthmus:

1) Infra isthmal fractures: the nail will not assist with reduction of the fracture.
2) Isthmal: easy reduction with appropriately sized medullary implant.

WINQUIST GROUPING OF COMBINED IPSILATERAL NECK AND SHAFT FEMUR FRACTURE [83]

Group 1: Combination of femoral shaft and non-displaced neck fracture. When found prior to nailing can be treated with screws and then retrograde nailing.

Group 2: Missed femoral neck fracture which is identified sequentially after nailing of shaft fracture. Insertion of screws around the nail. Avascular necrosis is minimal in these cases.

Group 3: Combination of femur shaft and displaced neck fracture. Appropriate treatment with implant is very essential for neck fracture, followed by shaft to be treated or single plating or nailing can be used to treat these.

MATERIALS AND METHODS

This is a retrospective and prospective study of 20 patients done over a period of 6 months from March 2016- September 2016 to assess the clinical, radiological and functional outcome of ipsilateral proximal femur fractures associated with femoral shaft fractures, treated either by Intramedullary nailing or by various Plate combinations at the Institute of Orthopaedics and Traumatology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai.

INCLUSION CRITERIA:

1. Patients aged above 15 years.

2. Patients with combined ipsilateral fractures of the femoral neck/intertrochanter region and shaft.

3. Patients with combined ipsilateral fractures of the proximal femur and segmental shaft of femur.

4. Ipsilateral fractures from same accident.

5. Closed fractures.

6. Patients who were treated earlier in our hospital for the same fracture and now came for follow up are included in the study retrospectively.

EXCLUSION CRITERIA:

1. Isolated femur neck/ intertrochanteric fractures.

2. Isolated shaft of femur fractures.

3. Pathological fractures.

4. Open fractures.

5. Ipsilateral fractures from two different consequent accidents.

6. Patients aged less than 15 years.

7. Associated Neurovascular injuries.

8. Distal femur fractures.

Patients were admitted through accident and emergency department after due counselling regarding the procedures, its implications, ethical issues and consent for surgery.

METHODOLOGY (Materials and Methods):

Patients with Ipsilateral proximal femur and femoral shaft fractures selected for clinical study as per inclusion / exclusion criteria were admitted.

A) MANAGEMENT IN THE CASUALTY

1. Patient's airway, breathing and circulation were assessed.

2. Other major injuries and life threatening injuries were ruled out.

4. To combat blood loss at the fracture site, IV fluids were started.

5. Limb was immobilized in Thomas splint or skeletal traction/skin traction.

6. Analgesics, antibiotics, tetanus toxoid and blood transfusion were given if necessary.

B) DATA COLLECTION AND METHODS: Patients were subjected to detailed history taking and clinical examination.

1. Detailed history was taken about age, sex, occupation, mode of injury, past history and associated medical illness.

2. Thorough clinical examination and general condition was assessed.

3. Associated orthopaedic and other systemic injuries were assessed and managed accordingly. All fractures are classified.

C) PRE OPERATIVE ASSESSEMENT:

1. ROUTINE BLOOD INVESTIGATIONS: Complete Hemogram., Renal Function Tests ,Urine routine examination, E.C.G.

2. RADIOLOGICAL EVALUATION

X-ray AP, Lateral, CT scan, CT angiogram, MRI evaluation according to injuries.

Chest PA/AP view – as a baseline radiograph to assess any development of fat embolism later.

Patients were categorized under the following headings in proforma:

3. SOCIO-DEMOGRAPHIC FACTORS:

Age, Sex, Occupation

4. TRAUMA RELATED FACTORS:

Mechanism of the injury, Mode of injury, associated injuries

5. Patients are selected as per surgeon's preference for either of two methods

Extramedullary screw-plate devices. Dynamic hip screws with a long side plate or combination with broad dynamic compression plate**.**

Intramedullary nail devices: Reconstruction nailing or proximal femoral nailing.

D) **PREOPERATIVE PREPARATION**

1. Patient were kept fasting for 8-10 hours before surgery

2. IV fluids were given as needed.

3. Adequate amount of blood were kept ready after cross matching if required in intraoperative and postoperative period.

4. IV antibiotic was given 30 min before surgery

Post-operative Functional assessment system adopted from Friedman and Wyman (1986) under the following criteria was used: **(FRIEDMAN SCORE)** The **CRITERIA** used to evaluate our results included

a) Time of union

b) Complications (Postoperative infection, and pain)

c) Shortening of limbs, range of movements at the hip and knee, ability to sit cross legged, squat and rotational mal-alignment.

Patients were followed up for outcome in terms of History &clinical examination, Functional ability in term of frequency of medication & status of working and daily activities, Radiological Assessment.

DATA MANAGEMENT AND STATISTICAL ANALYSIS:

The data were entered in EXCEL sheet and further analysis were done using software SPSS. Continuous variables were summarized as mean and standard deviation and the significance between their mean variables are analysed using T test.

CLINICAL AND RADIOLOGICAL ASSESSMENT

On receiving the patient in emergency department, general condition is assessed rapidly. Primary survey of airway, breathing, and hemodynamic status is done and resuscitation is done. Secondary survey is done in detail to assess the skeletal examination, examination of abdomen and pelvis and central nervous system.

History is important as the mode of injury gives the magnitude of force and its direction on which the pattern, displacement and comminution of fracture depends.

Physical examination includes thorough inspection for external injuries, wounds, contusions and bruises. Attitude of the injured limb and its distal neurovascular status must be seen.

RADIOLOGICAL INVESTIGATIONS:

After clinical assessment, patient is shifted for radiological assessment if the patient's condition is stable.

- X-ray and CT scan form the standard protocol.
- X-ray pelvis with both hips-Antero-posterior.
- X-ray of ipsilateral hip in 15 degrees of internal rotation.
- X-ray full length femur: antero-posterior and lateral
- X-ray knee joint: antero-posterior and lateral

In patients with femoral shaft fractures, there is high incidence of missed femoral neck fractures. Therefore it is recommended to review all available imaging modalities, at multiple time points in the patient's evaluation and treatment.

1. Dedicated hip x-rays should be obtained as part of the initial radiologic evaluation in any patient with a femoral neck fracture.

2. Second, if pelvic oblique radiographs are taken suspecting ipsilateral acetabular fracture, these should be scrutinized for femoral neck fractures.

3. Third, if CT scan is done for abdominal or pelvic trauma, this should be reviewed. Occult fractures are frequently demonstrated on the relevant axial images.

4. Fourth, intraoperative fluoroscopic images before starting nailing.

5. Fifth, hip fluoroscopic images and/or x-rays should be taken after femoral shaft stabilization. The hip should be in 10 to 15 degrees of internal rotation.

6. Finally, before leaving the operating room, dedicated postoperative hip x-rays should be taken to confirm the femoral neck integrity.

Tornetta et al used a best-practice protocol consisting of dedicated

Internal rotation plain x-ray.

- 2-mm CT scan through the femoral neck.
- Fluoroscopic lateral of the femoral neck before fixation.
- Post-operative orthogonal hip x-rays in the operative room.

In the year 2007, by using this protocol Tornetta et al[33] showed improvement in the rate of diagnosing missed femoral neck fractures, in patients who had sustained femoral shaft fractures.

It should be borne in mind to look for:

- Associated pelvic ring injuries
- Ipsilateral knee injuries
- Congruency of femoral head in acetabulum
- Ipsilateral and contralateral limb injuries.

CT SCAN

CT scan helps in identification of fracture lines not visualized by radiographs and orientation of fracture line and rotation of fracture fragments, and degree of fracture comminution.

3-D CT SCAN

It is converted from 2 dimensional CT scan data. Image quality determined by software. Provides a good overall picture of the fracture configuration.

SURGICAL TECHNIQUES (For Nailing)

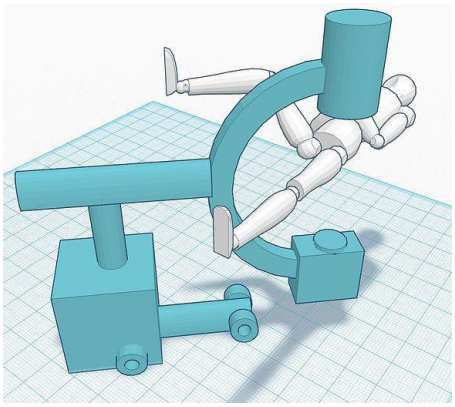
1) Proper preoperative planning

Appropriate nail diameter and length were planned by measuring at the isthmus.

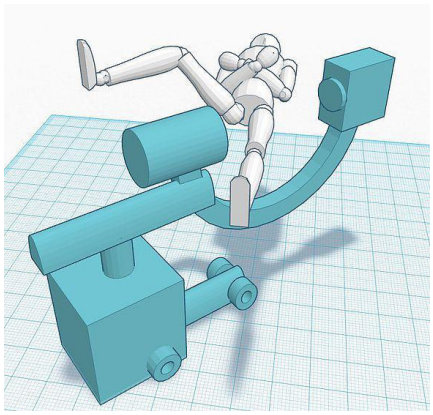
2) Patient positioning and radiographic control

Patients were put on Supine position on a fracture table.

Excellent AP and lateral images of the femoral head and neck were taken before the procedure. Access to the greater trochanter was improved by bending the torso away from the affected extremity adducting the affected limb.



Antero-posterior view



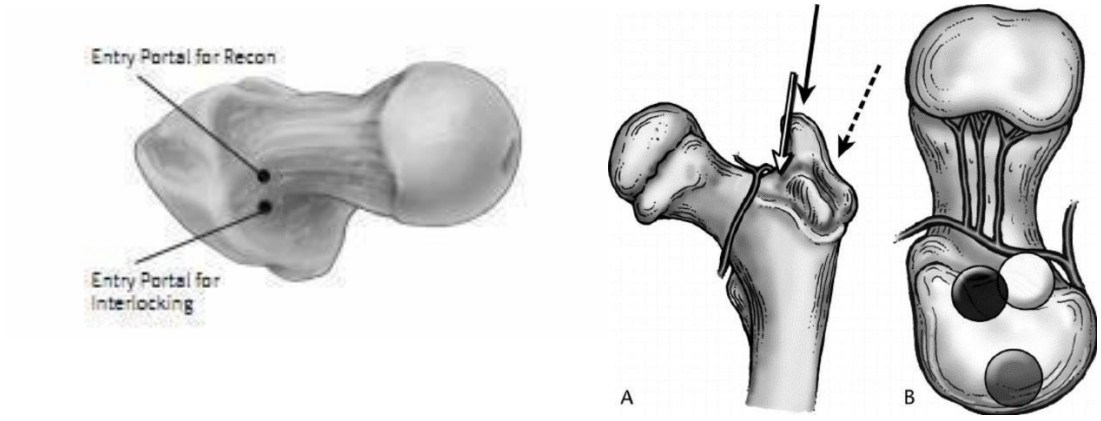
Lateral view

3) Reduction of the fractures was attempted before beginning the surgical procedure

4) Incision and exposure.

Skin incision was started 1cms proximal to the greater trochanter and extended proximally for 5cms in the line of the gluteus maximus. After dissection, the muscles were retracted to visualize the pyriform fossa.

5) Correct entry portal was determined using C arm; 5mm anterior to the standard interlocking nail, this was done to facilitate screw placement in the center of the neck.



White arrow/circle: pyriform fossa entry point (standard IL nail)

Black arrow/circle: tip of greater trochanter entry point (PFN)

Interrupted arrow/grey circle: lateral trochanter entry(Recon nail with lateral entry)

Checked the position of entry hole with awl: on AP view, the awl should lie at the base of the femoral neck adjacent to the greater trochanter.

6) A guide wire was inserted through the piriformis fossa into the canal of the proximal fragment and reaming was performed. A 3mm ball tip guide wire-bent at 10 degrees, 5cms from the end was used to aid in fracture reduction by rotating the guide.

7) The guide wire was replaced with smooth guide wire and reaming done in the distal fragment.

Using cannulated reamer, medullary canal is opened.

8) Nail insertion: The proximal femoral canal was enlarged to 1mm larger than the distal femoral canal. Reconstruction nail, 1mm smaller than the distal reaming was inserted along the guide wire into the distal femur.

9) The lower limb was then abducted 15^0.The neck shaft angle was checked by image intensifier. Femoral proximal targeting guide was fitted.

10) Proper ante-version for the locking screws was ensured. A Steinmann pin was fixed per-cutaneously along the anterior aspect of the trochanter, parallel to the neck, and checked in C-arm. During insertion, the femoral proximal guide was ensured to remain parallel to this pin to ensure proper anteversion of the locking screws.

11) In case of excessive resistance during nail insertion-over reaming the canal or choosing smaller size nail was resorted.

12) Two proximal locking and two distal locking screws were inserted. Excessive twisting or torque to the femoral guide was avoided to ensure proper targeting. 5.5mm recon screws were used for proximal locking.

13) Distal locking was done by free hand technique.

14) Position of both screws was checked with c-arm in AP and lateral planes.

15) Nail extraction if required was done using threaded extractor and slap hammer.

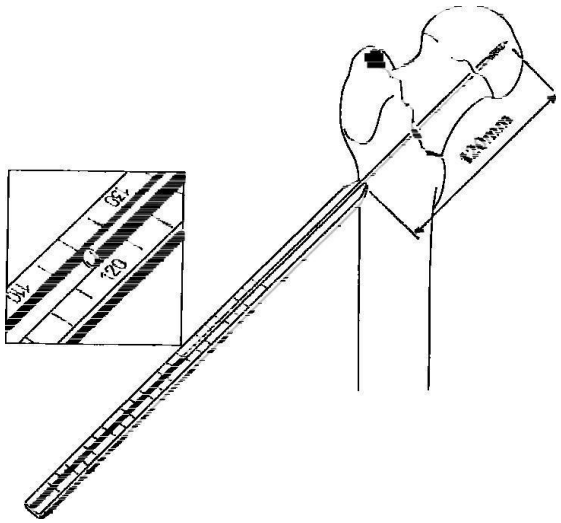
Surgical techniques for Plating:

Shaft of femur plating with broad dynamic compression plating done first if DHS plate with BDCP plate combination is used. If long DHS plate is used then shaft fracture is provisionally fixed initially then plating done.

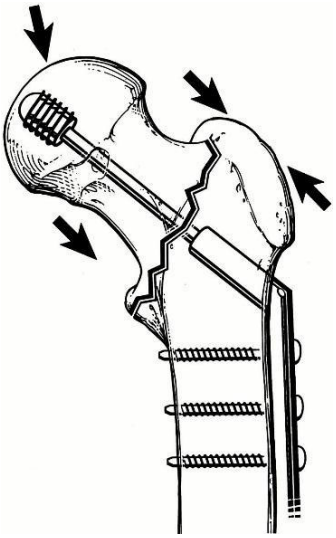
Approach: Using lateral approach skin incision about 15 cm long, beginning two finger breadths above the tip of the greater trochanter. Split the iliotibial tract longitudinally. L-shaped division of about 1 to 1.5 cm of the vastus lateralis is made to expose proximal femur. Insert retractors anteriorly in the region of proximal femur.

- Reduce the fracture by flexion, longitudinal traction, abduction and internal rotation.
- Insert ante-torsion k wire through anterior aspect of femur neck

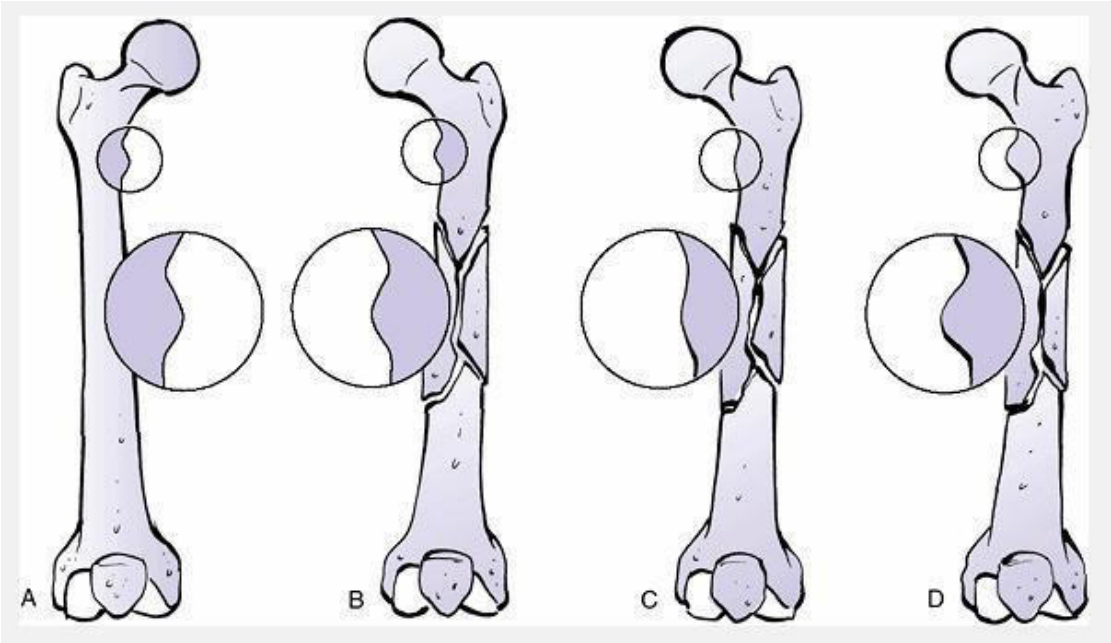
- Using DHS angle guide, guide wire inserted at an angle of 130-135 degrees.



- Check position of guide wire using c-arm both AP and Lateral views.
- After measuring screw length, triple reaming to be done.
- Screw with measured length to be inserted and DHS plate introduced and fixed with cortical screws.
- Finally compression screw is applied after release of traction.

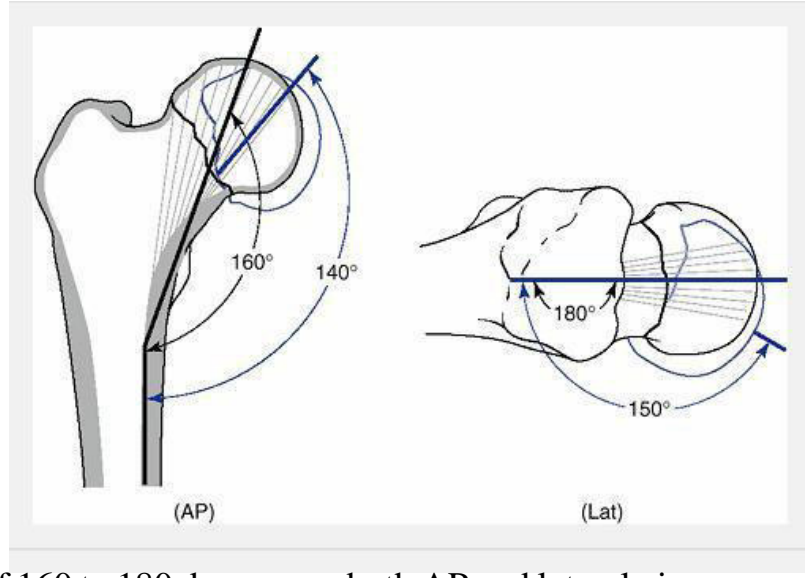


INTRAOPERATIVE DETERMINATION OF FEMORAL ROTATION BY SHAPE OF THE LESSER TROCHANTER



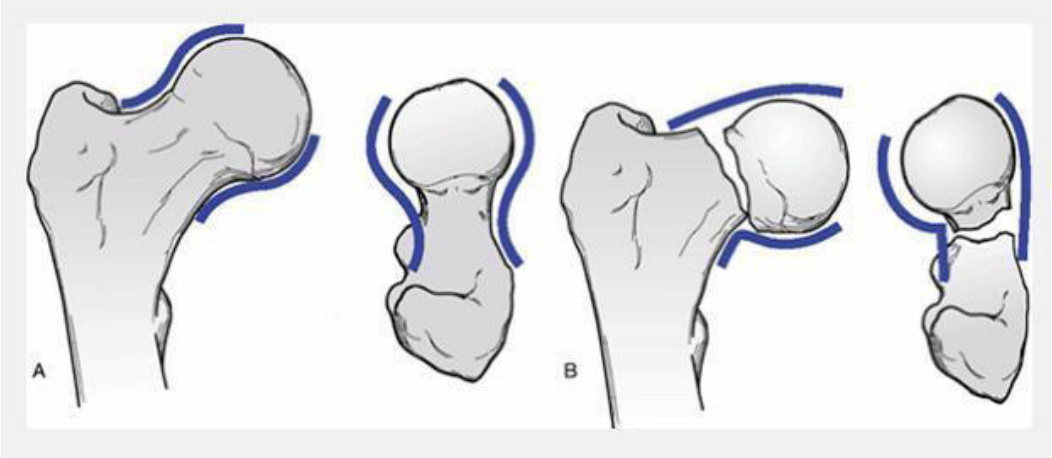
A. Antero-posterior fluoroscopic image of the uninjured proximal femur with femur in neutral rotation is stored.
B. The rotation of proximal segment is adjusted before interlocking, so that contour and shape of the lesser trochanter are identical.
C. The lesser trochanter will appear smaller, if the proximal segment is internally rotated.
D. The lesser trochanter will appear larger, if the proximal segment is externally rotated.

GARDENS ALIGNMENT INDEX



Angle of 160 to 180 degrees on both AP and lateral views was considered acceptable by Garden. Anatomic (black) and unacceptable (blue) reductions are shown.

LOWELL INDEX



The cortices of an anatomically aligned femoral head and neck. On both x-ray views, they will project shallow S- or reverse S- shaped curves (A). Mal-alignment: Flattening of one curve and sharp apex on opposite side (B). Findings are easier to appreciate by intraoperative fluoroscopy, than the alignment index, measured by trabeculae.

POST OPERATIVE PROTOCOL

- All patients were given antibiotics postoperatively for 5 days.
- Drain removal was done on 2nd post-operative day.
- Suture removal was done on post-operative day 12 to 14.
- Patients were advised Non weight-bearing activities for 6 weeks.
- Graduated partial weight-bearing activities were advised for another 6 weeks.
- Radiological and functional examination was done on monthly review for first 6 months and third monthly thereafter.

ANALYSIS

Patient general ambulatory status, range of motion and functional status were assessed using the Freidman and Wyman assessment system at each follow up.

Functional Outcome-Freidman and Wyman System

Result	Activities of daily living	Pain	Range of motion
Good	No limitation	Nil	<20% loss of hip or knee motion
Fair	Mild limitation	Mild to moderate	20-50% loss of hip or knee motion
Poor	Moderate limitation	Severe	>50% loss of hip or knee motion

Post-operative Radiological assessment:

Union: 80% of fracture gap is filled with bone trabeculae

Angular mal-alignment: > 5 degrees of angulation in either the coronal (varus-valgus) or sagittal (flexion-extension) planes.

Rotational mal-alignment: >15 degrees

Delayed union and nonunion were contemplated, if the fracture showed no signs of union by 6 months and 12 months for shaft fractures.

INTRA OPERATIVE DIFFICULTIES & POST OPERATIVE COMPLICATIONS

The intraoperative difficulties for intramedullary nailing are:

1) Incorrect entry point.
2) Iatrogenic comminution of fracture site during nail insertion.
3) Shattering of the proximal femur during nail insertion.

   Bursting of the femur could occur because of mismatch in curvature of the nail and femur, or because of high bending stiffness of the nail, or because of incorrect entry point.
4) Displacement of the undisplaced femoral neck fracture
5) Distraction at the femoral shaft fracture site.
6) Failure in achieving closed reduction, leading to open reduction.
7) Improper placement of proximal screws in the femoral neck.

The intraoperative difficulties for DHS with plating/ plate combinations are:

1. Improper positioning of compression screw
2. inadequate fracture reduction
3. breakage of K-wire
4. improper technique and faulty placement of the side plate
5. fracture of the distal fragment of the fracture
6. Mal-rotation of segmental fragment.

Post-Operative Complications:

1) Delayed union & Non-union: Femoral neck fractures should unite by 6 months. A delayed union (>3 months) or nonunion (>6 months) should be contemplated, if there is no evidence of healing, or alternatively if the patient continues to have pain at 3 to 6 months after surgery.

2) Malunion: Angular deformity of the femur is defined as greater than 5 degrees of angulation in either

- the coronal plane (varus-valgus)
- (or) sagittal (flexion-extension) plane.

A properly aligned entry point will minimize angular deformities.

Rotational mal-alignment is defined as more than 15 degrees of rotational mal-alignment and is common in unstable fractures with Winquist type 3 and 4 comminution.

3) Shortening of the femur and limb length discrepancy

4) Infection and infected non union

5) Implant failure

6) Iatrogenic nerve injury: Sciatic and peroneal nerve injuries can occur because of stretching of the nerve. Pudendal nerve palsy is associated with use of fracture table.

7) Muscle weakness can occur because of injury to abductors of hip and external rotator muscles.

8) Osteonecrosis and degenerative joint disease are rare

Long-term complications.

9) Heterotopic ossification

10) Re fracture of the femur after removal of the intramedullary nail has been reported.

11) Pain in the outer aspect of the proximal part of thigh necessitates reconstruction nail removal.

12) Knee stiffness and Knee pain.

The advantages of the intramedullary nail technique in treating ipsilateral fractures of the femoral neck and femoral shaft are:

1) less blood loss,

2) a closed technique,

3) less soft tissue trauma,

4) Biological fixation for both fractures using single implant.

The main advantage of plating method is easy technique and most surgeons are technically familiar with the procedure.

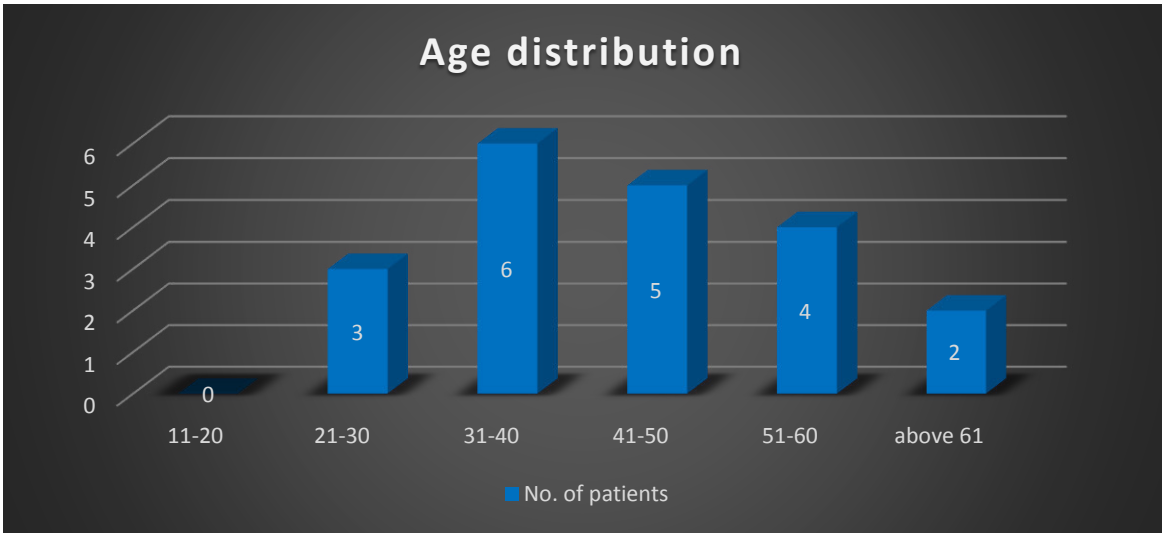
OBSERVATION AND RESULTS

This is a study of 20 patients with Ipsilateral proximal femur fracture with femoral shaft fracture treated with either intramedullary nailing method or DHS and plating methods.

Age distribution

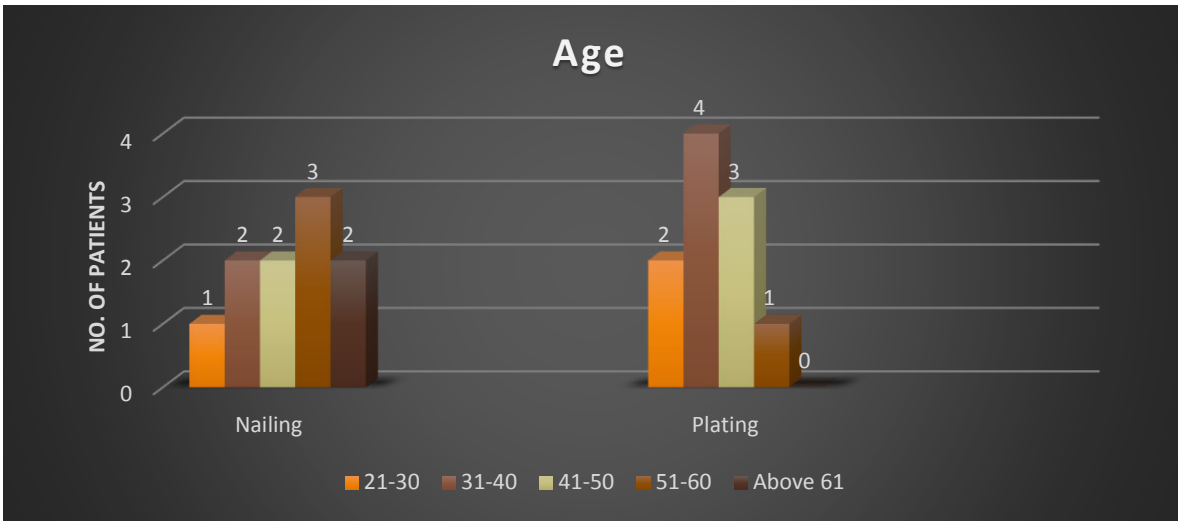
Age in years	No. of patients	percentage
11-20	0	0
21-30	3	15
31-40	6	30
41-50	5	25
51-60	4	20
Above 61	2	10

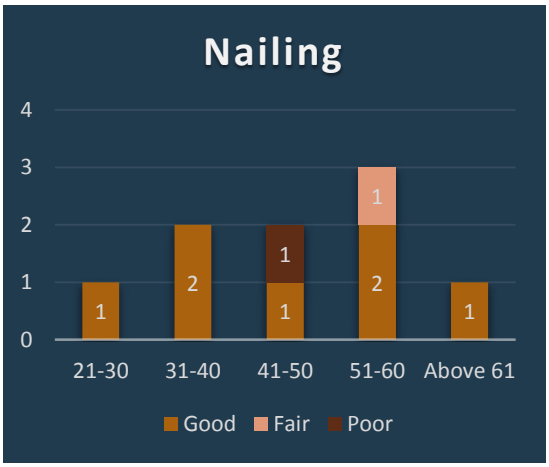
We found that ipailateral proximal femur and femoral shaft fractures are common in 3rd,4thand 5th decades of life. Mean age is 44 years**.**

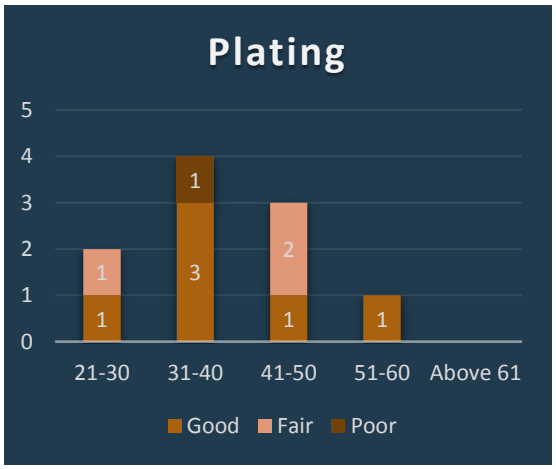


Age significance

Variable			Good	Fair	Poor	Total
Age in yrs	21-30	Nailing	1			1
		Plating	1	1		2
	31-40	Nailing	2			2
		Plating	3		1	4
	41-50	Nailing	1		1	2
		Plating	1	2		3
	51-60	Nailing	2	1		3
		Plating	1			1
	Above 61	Nailing	1	1		2
		Plating				0





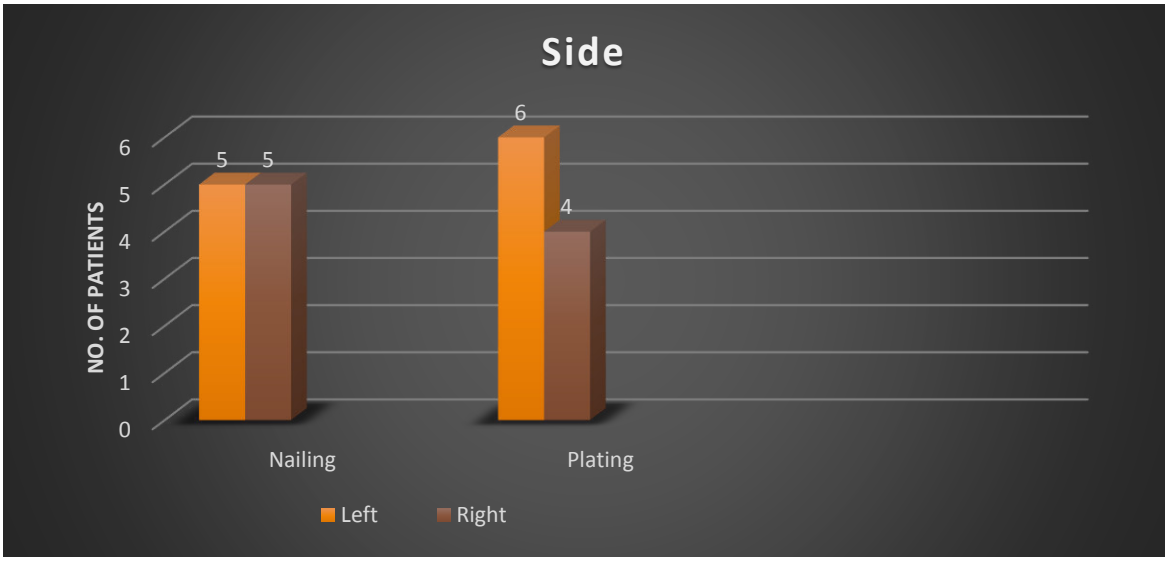


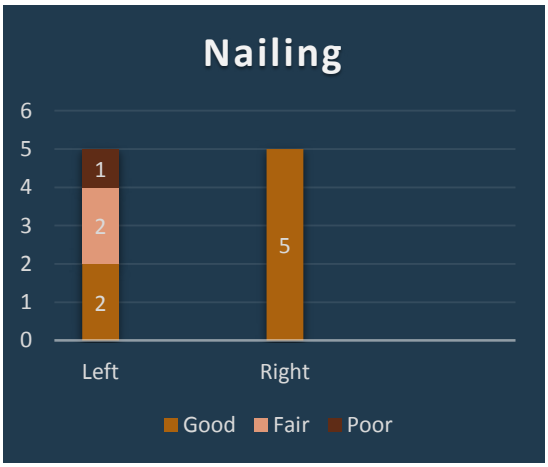
Sex incidence

All 20 patients were males.

Side

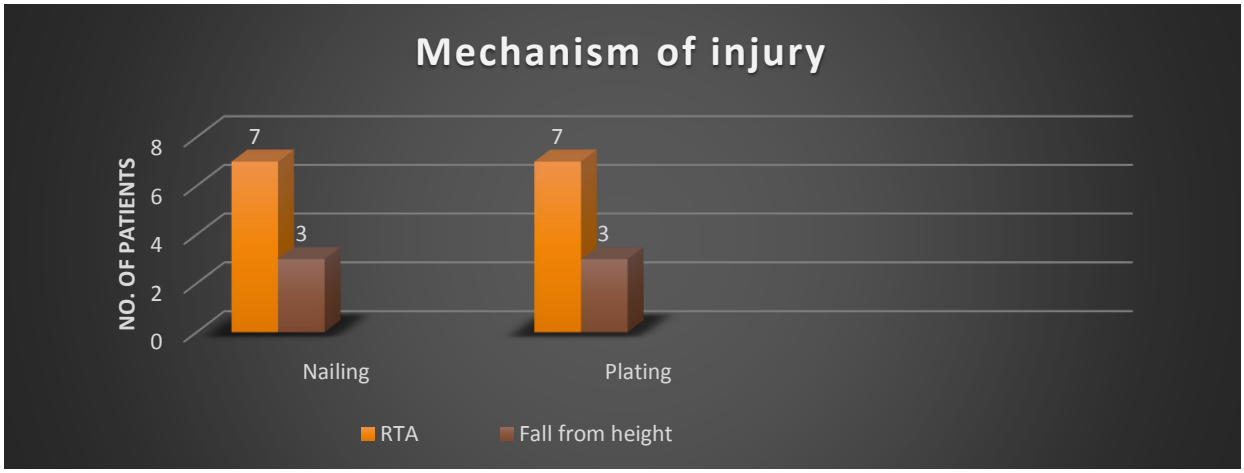
Variable			Good	Fair	Poor	Total
side	Left	Nailing	2	2	1	5
		Plating	5	1		6
	Right	Nailing	5			5
		Plating	1	2	1	4

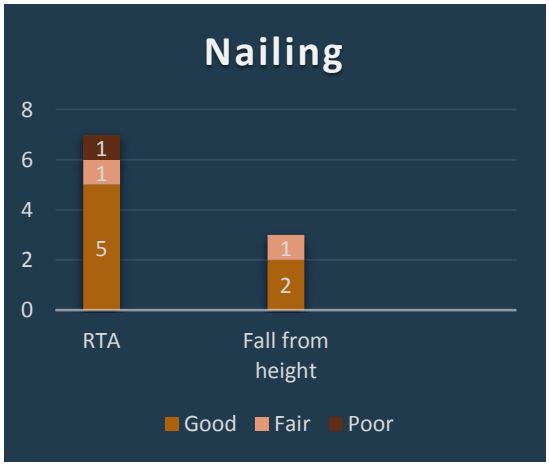


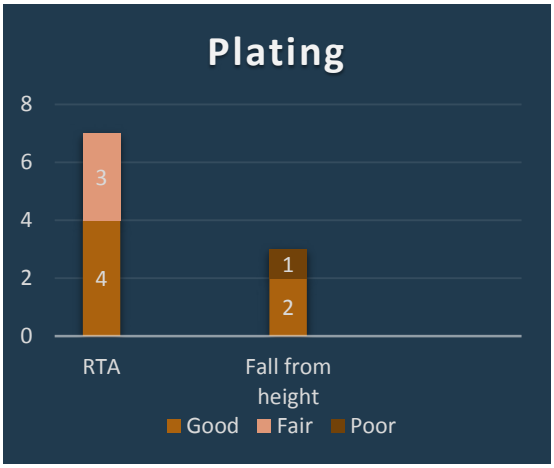


Mechanism of injury

Variable			Good	Fair	Poor	Total
Mechanism of injury	RTA	Nailing	5	1	1	7
		Plating	4	3		7
	Fall from height	Nailing	2	1		3
		Plating	2		1	3

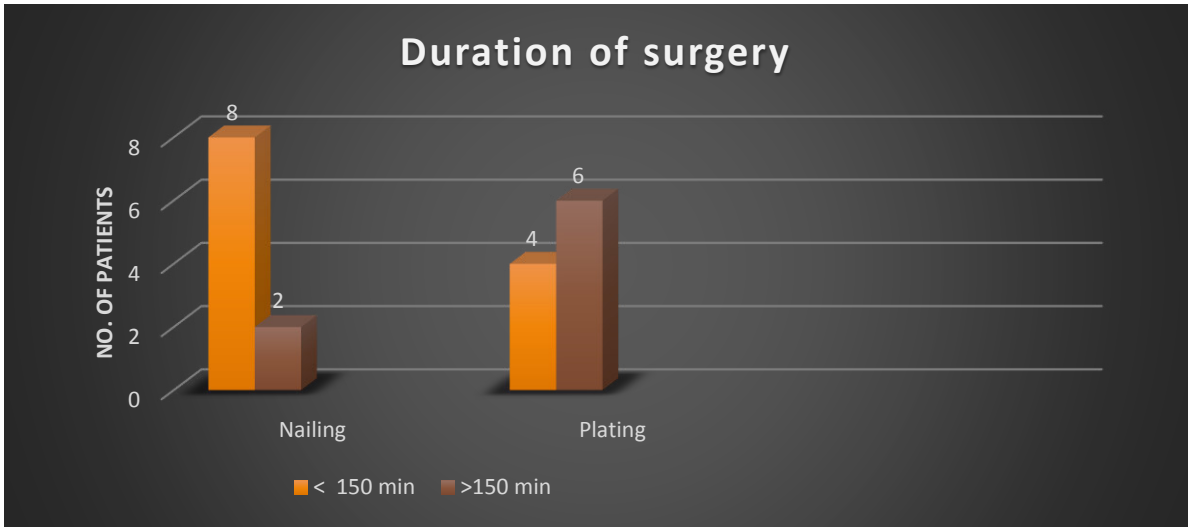


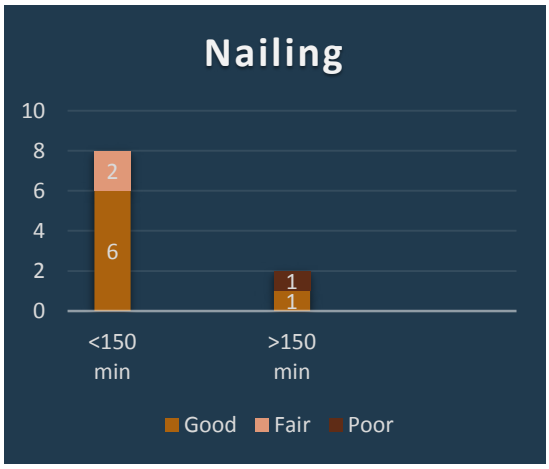


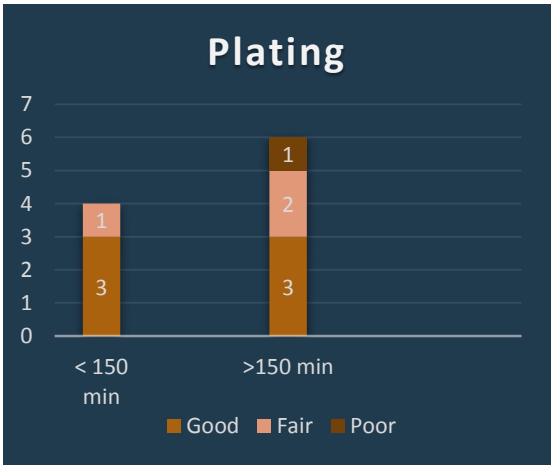


Duration of surgery

Variable			Good	Fair	Poor	Total
Duration of surgery	< 150 min	Nailing	6	2		8
		Plating	3	1		4
	> 150 min	Nailing	1		1	2
		Plating	3	2	1	6





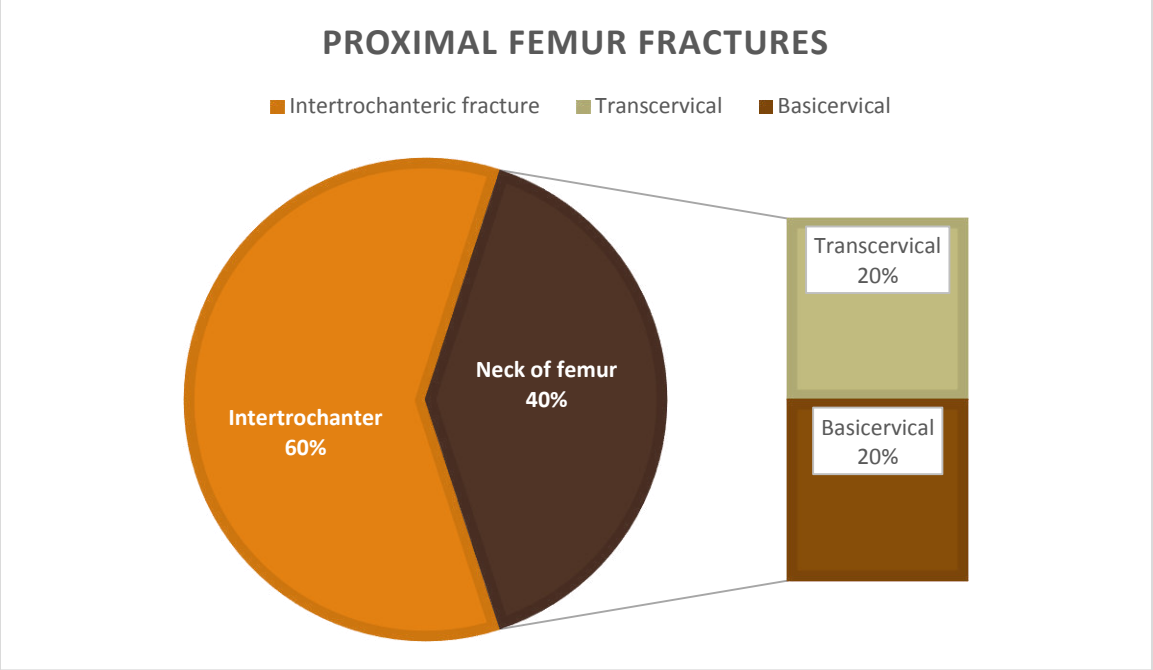


Fracture patterns:

Proximal femur fractures

There were 12 patients with intertrochanteric fracture and 8 patients with neck of femur fracture.

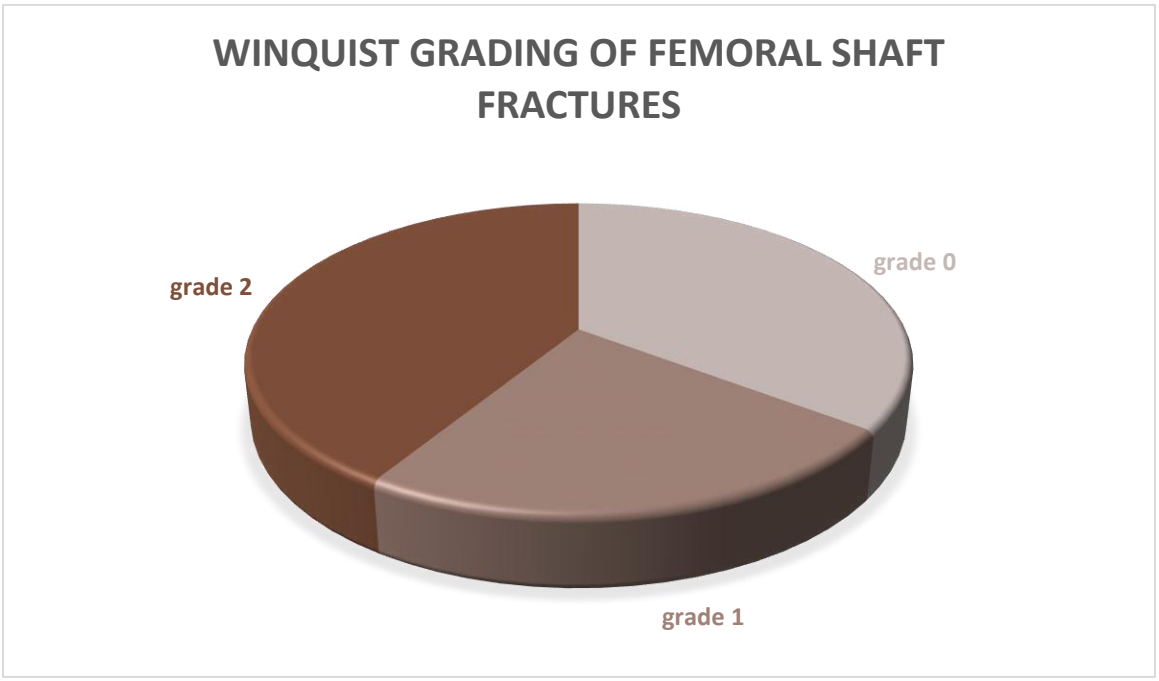
Fracture pattern	No. of patients	Percentage
Inter-trochanteric	12	60
Transcervical displaced	4	20
Basicervical undisplaced	2	10
Basicervical displaced	2	10



Femoral shaft fractures:

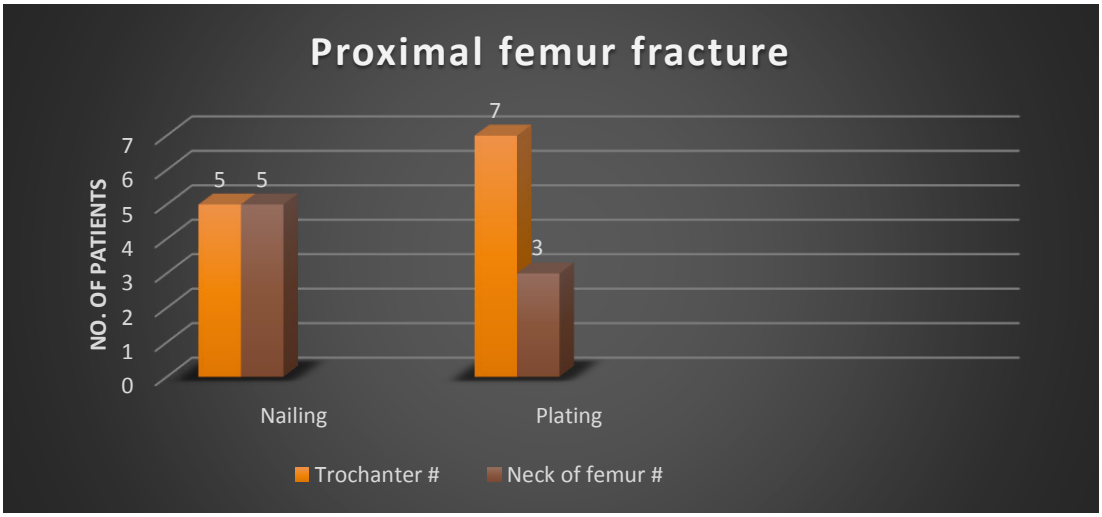
All femoral shaft fractures were closed. There were 19 cases with fractures in middle third, 1 patient with fracture in proximal third and 3 segmental fractures.

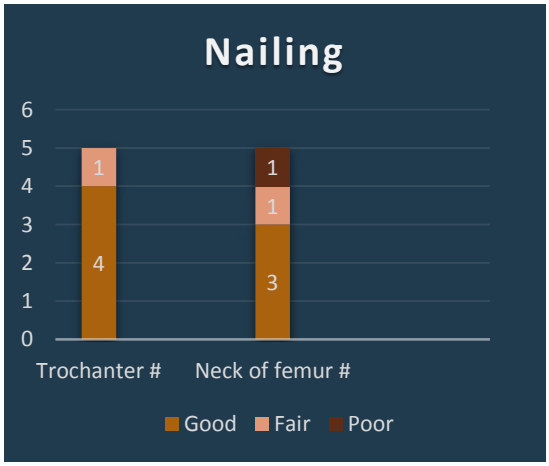
Winquist grading of femoral shaft fractures	**No. of fractures**
Grade 0	6
Grade 1	4
Grade 2	7

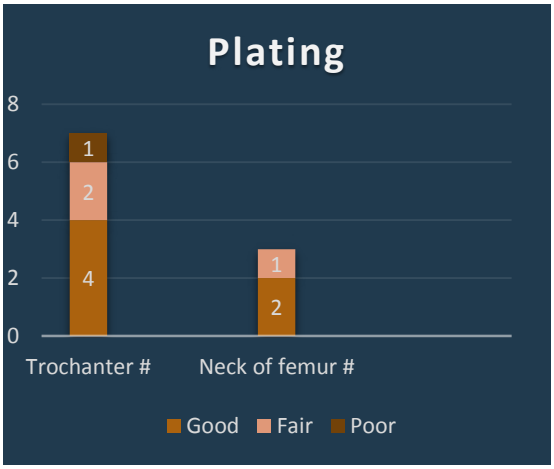


Proximal femur fractures

Variable			Good	Fair	Poor	Total
Proximal femur fracture	Trochanter #	Nailing	4	1		5
		Plating	4	2	1	7
	Neck of femur #	Nailing	3	1	1	5
		Plating	2	1		3

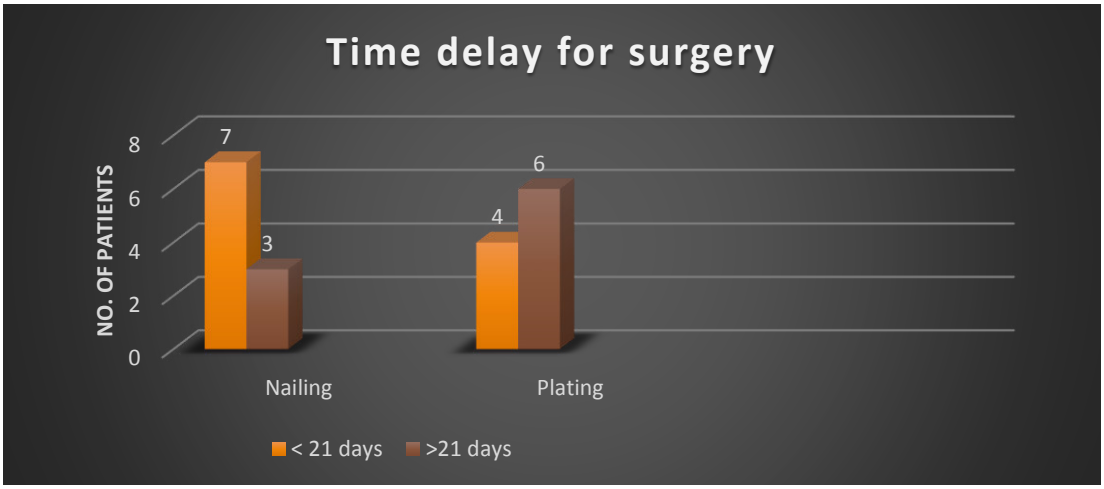


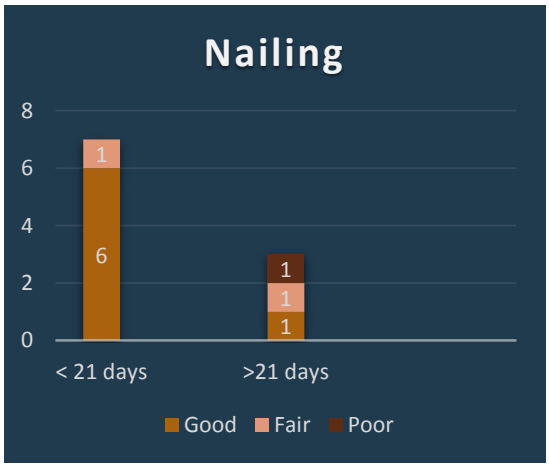


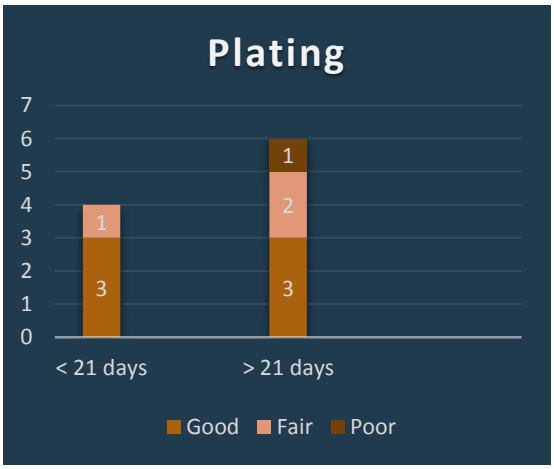


Time delay for surgery

Variable			Good	Fair	Poor	Total
Time delay in days	< 21 days	Nailing	6	1		7
		Plating	3	1		4
	>21 days	Nailing	1	1	1	3
		Plating	3	2	1	6



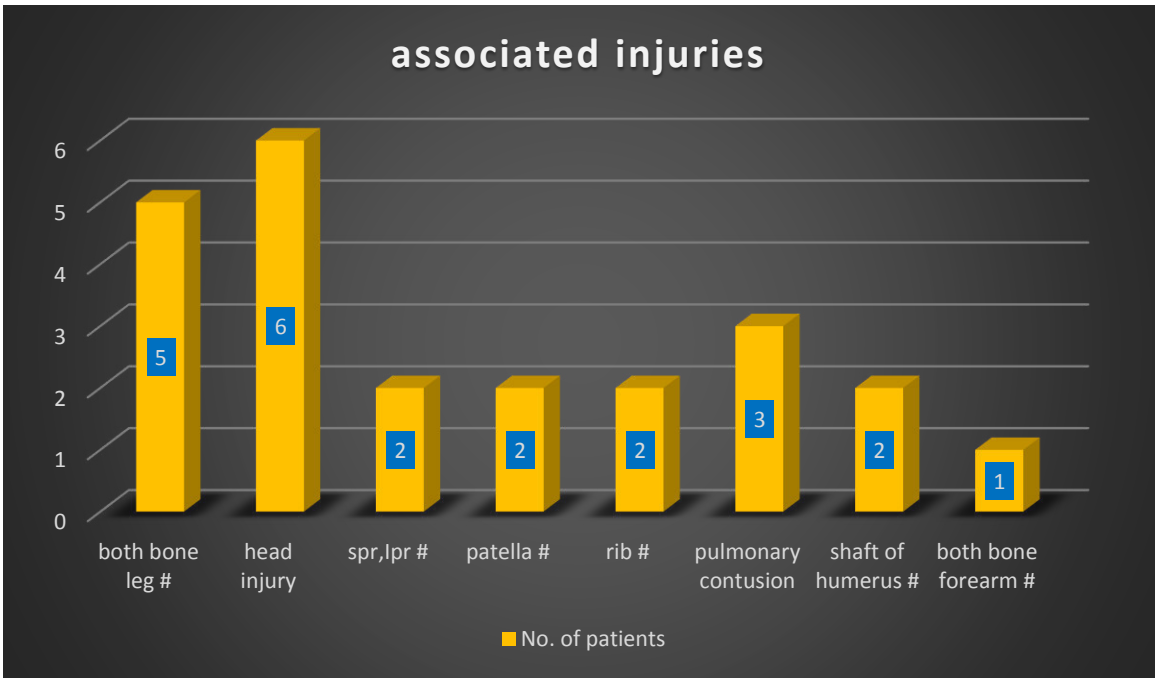




Associated injuries

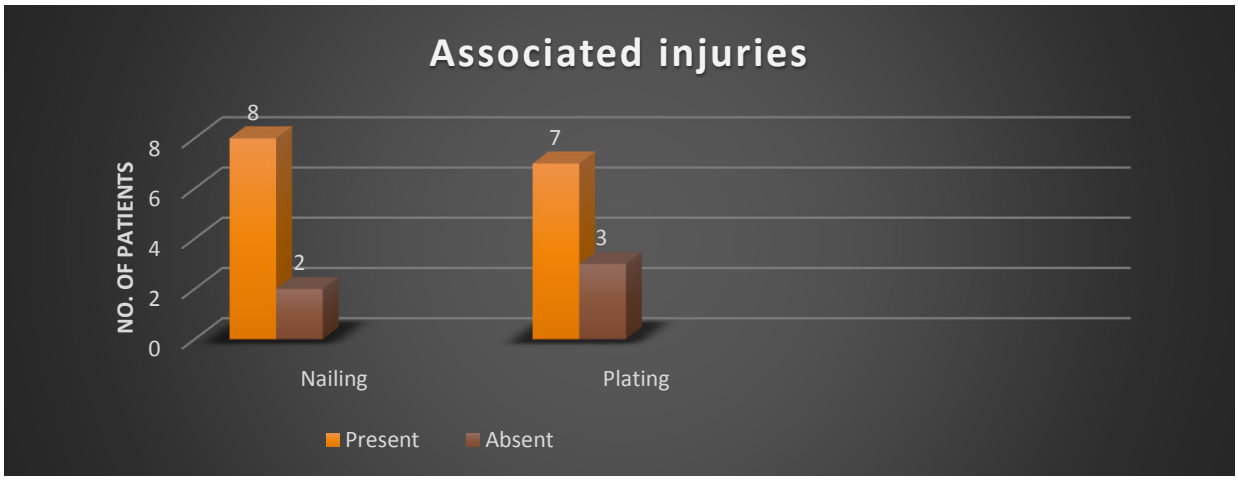
There are 15 patients with associated injuries.

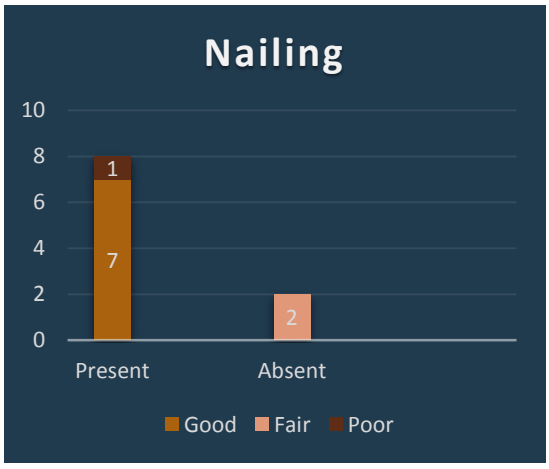
Associated injuries	No. of patients
Fracture both bone leg	5
Fracture patella	2
Fracture superior pubic rami	2
Fracture inferior pubic rami	2
Rib fracture	2
Pulmonary contusion	3
Head injury	6
Fracture humerus	2
Fracture both bone forearm	1

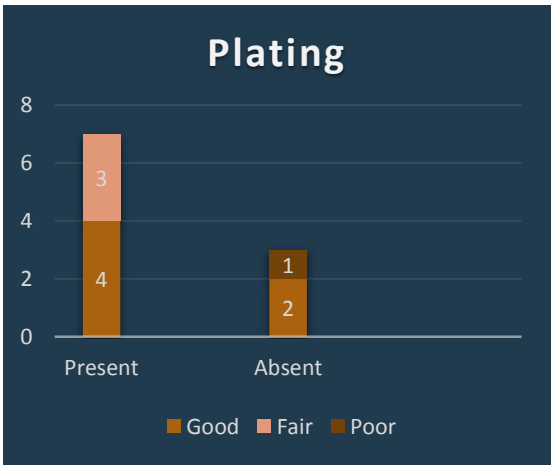


Associated injuries

Variable			Good	Fair	Poor	Total
Associated injuries	Present	Nailing	7		1	8
		Plating	4	3		7
	Absent	Nailing		2		2
		Plating	2		1	3

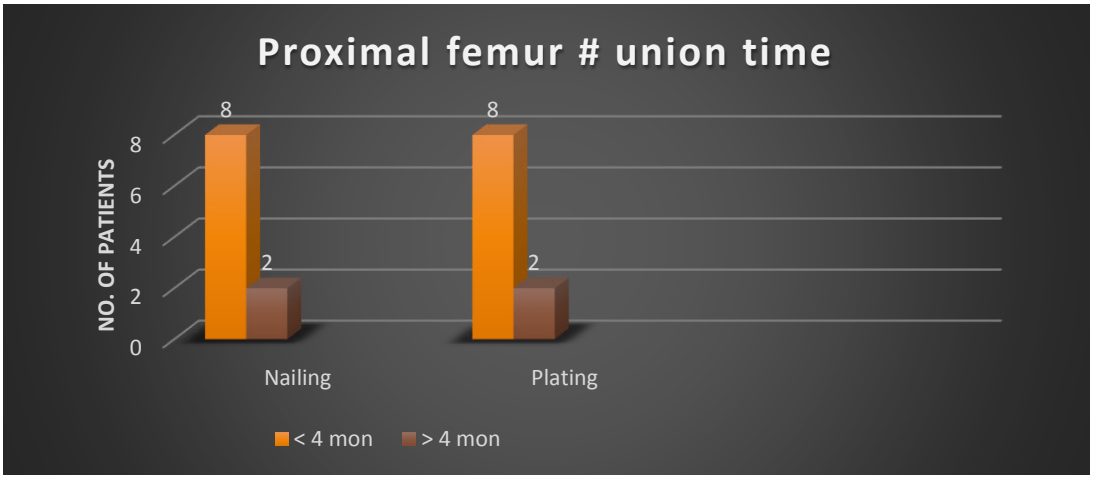


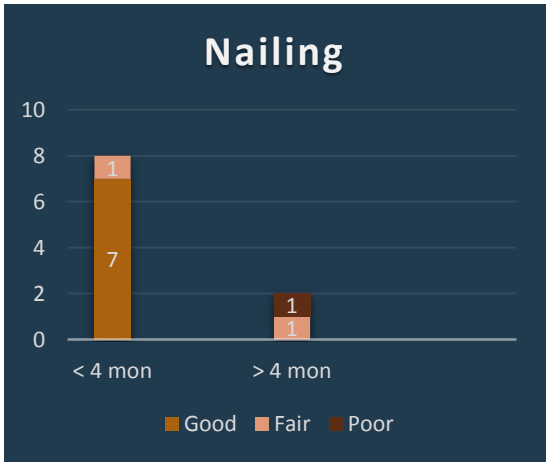


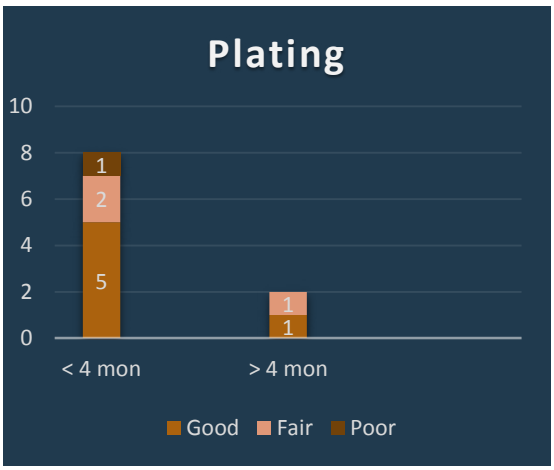


Time of fracture union

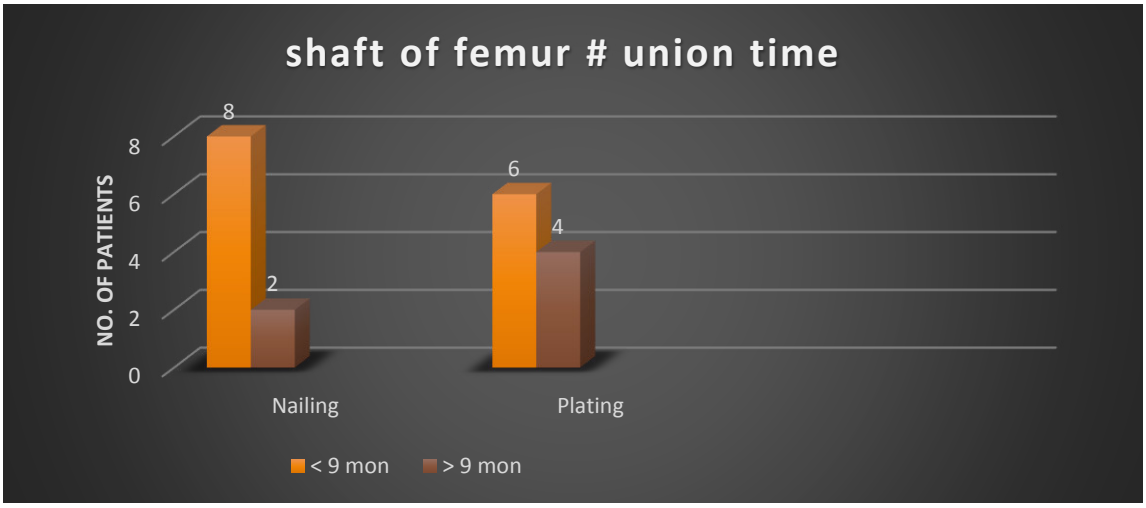
Variable			Good	Fair	Poor	Total
Time of union Proximal femur	< 4 mon	Nailing	7	1		8
		Plating	5	2	1	8
	>4 mon	Nailing		1	1	2
		Plating	1	1		2

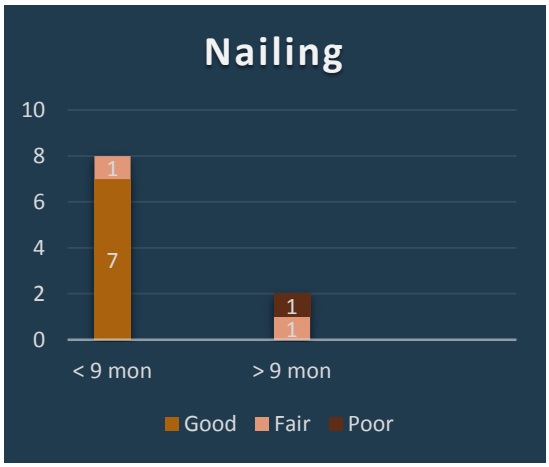






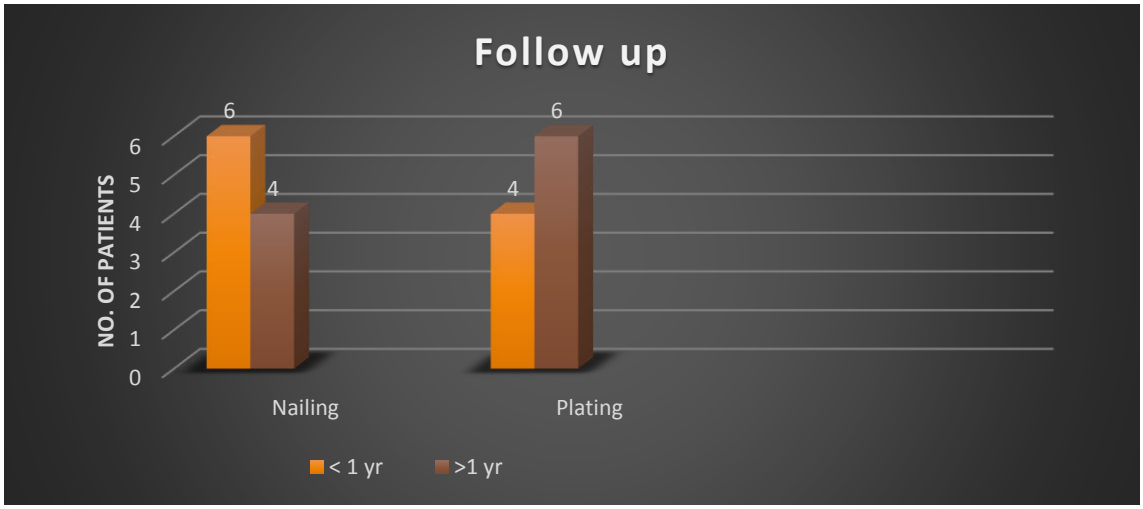
Variable			Good	Fair	Poor	Total
Time of union Shaft of femur	< 9 mon	Nailing	7	1		8
		Plating	5	1		6
	>9 mon	Nailing		1	1	2
		Plating	1	2	1	4

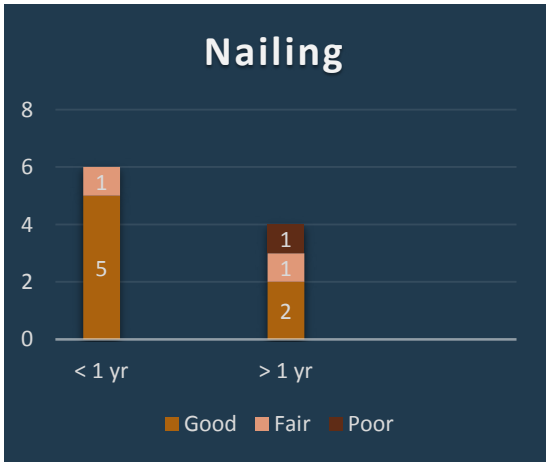




Follow up

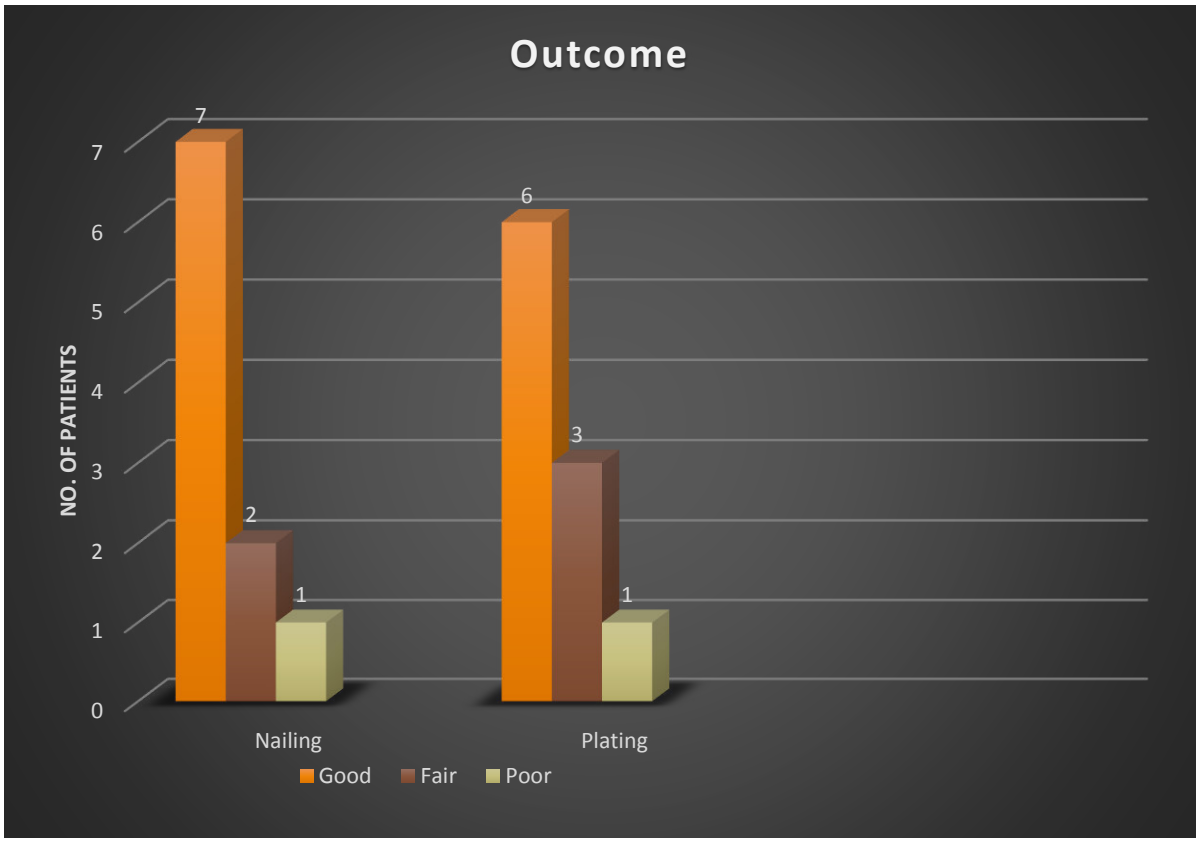
Variable			Good	Fair	Poor	Total
Follow up	<1 yr	Nailing	5	1		6
		Plating	2	1	1	4
	>1 yr	Nailing	2	1	1	4
		Plating	4	2		6





Outcome

Variable		Good	Fair	Poor	Total
Outcome	Nailing	7	2	1	10
	Plating	6	3	1	10



STATISTICS

variable	Group	Mean	Standard deviation	Std. error mean
Age	Nailing	4.30	1.337	.423
	Plating	3.30	.949	.300
Time delay	Nailing	22.00	13.157	4.161
	Plating	27.00	10.750	3.399
Surgery duration	Nailing	140.00	24.037	7.601
	Plating	158.00	18.738	5.925
Proximal femur Union time	Nailing	3.78	.972	.324
	Plating	3.80	.789	.249
Shaft of femur Union time	Nailing	8.00	1.414	.471
	Plating	10.22	3.768	1.256
Follow up	Nailing	14.30	4.855	1.535
	Plating	14.90	3.929	1.242

Independent Samples Test

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
age	1.928	18	.070	1.000	.519	-.089	2.089
Time delay	-.931	18	.364	-5.000	5.373	-16.288	6.288
Surgery duration	-1.868	18	.078	-18.000	9.638	-38.248	2.248
Union time	-.055	17	.957	-.022	.404	-.875	.831
Union time month	-1.657	16	.117	-2.222	1.341	-5.066	.621
Follow up	-.304	18	.765	-.600	1.975	-4.749	3.549

Discussion

Ipsilateral proximal femur and shaft of femur fractures are uncommon patterns of injuries and these constitute about 2.5-9% of femur fractures.[52,59] Our study had 20 patients with combined proximal femur (neck/intertrochanteric) fractures and femoral shaft fractures.

Of these patients, the proximal femur fractures are of intertrochanteric variety in 13 cases, basicervical neck type in 4 cases and transcervical neck in 3 cases.

Of the femoral shaft fractures, 6 patients fall into winquist grade 0, 4 patients into winquist grade 1 and 7 patients into winquist grade 2. Segmental shaft of femur fracture in 3 patients.

These trauma victims are usually in the 3rd and 4th decades of age. These patients are usually associated with life threatening injuries like head injury and chest injury and other limb injuries which includes both bone leg fractures, patella fractures, pelvic bone injuries, fractures of humeral shaft and forearm bones.

All patients in our study were males. Operations were carried out with a mean time delay of 22 days in nailing group and 27 days in plating group. The time delay in operative fixations were according to patient status as they are polytrauma victim with life threatening injuries and other system injuries [72].

We have compared our study with other studies reported by jain et al in 2001[4], kao et al in 2006[62], Tsai et al in 2008[68], Abalo et al in 2008[57], WM Gadegone et al in 2016[49] and Sreekanth kashayi-chowdojirao et al in 2016[72].

The average follow up in these studies were 2.16 years, but in our study the average follow up was only 1.2 years. Only 6 patients had follow up of more than 1 ½ yrs.

The proximal femur fracture union rate in our study was 100% in plating group and 90% in nailing group. The nonunion neck fracture in nailing group was due to infection and was operated with nail exit and antibiotic coated nailing with excision arthroplasty. Similarly jain, kao, and WM Gadegone reported more than 95% for neck fracture union rate. Other studies by Tsai, Abalo have reported more than 90%. Sreekanth study reported 100% union rate.

The shaft fracture union rate was 90% in nailing and 80% in plating groups. Jain reported 83%, Kao 69%, Tsai 78%, Abalo 87%, WM Gagedone 94% and sreekanth reported 100% for nailing and 92% for plating groups.

All the three shaft nonunion cases in our study (1 in nailing group, and 2 in plating group) were due to infection, the operating time in these cases were around 3 hours and belong to winquist grade 2 femur shaft fractures in 2 cases and segmental type in one patient.

Comparison of clinical outcomes with intramedullary nail, DHS with compression plating to treat ipsilateral femoral neck and shaft fracture

Authors	Case number	procedure	Union rate (%)		Union time (months)		Varus neck	Osteo necrosis (%)	Infection (%)	Follow up Years
			neck	shaft	Neck	shaft				
Jain (2004)	**23**	Recon nail	96	83	4	5.5	0	4	0	2.5
Kao (2006)	**13**	Recon nail	95	69	3	8.5	0	0	0	2.5
Abalo (2008)	**37**	DHS with BDCP	91	87	4	6	1	0	18.9	4
Tsai (2009)	**32**	Recon nail	91	78	4	8.8	0	0	0	1.9
WM Gadegone (2016)	**36**	Long PFN	97	94	4.8	6.2	0	2	5	1
Sreekanth (2016) comparison	**25**	Nailing	100	100	4.5	5	0	0	0	1.2
		Plating	100	92	4	5	0	0	0	1.3
Our study (2016)	**20**	nailing	90	90	3.7	8.0	0	0	20	1.2
		plating	100	80	3.8	8.4	0	0	20	1.3

The average neck union time in our study 3.7 months in nailing group and 3.8 months in plating group, compared to 3 - 4.8 months in other studies.

The average shaft union time was 8 months in nailing group and 8.4 months in plating group, compared to 5-8.8 months in other studies.

There was no varus neck in our study. Except Abalo (varus neck-1), all other studies reported no varus union.

One patient with trochanter malunion in nailing group (reconstruction nail) was due to proximal femoral shattering and displacement during nail insertion.

In a short follow up of 1.2 years, there was no cases of osteonecrosis based on x ray features. Jain reported 4 cases of osteonecrosis in 2 year follow up and WM Gagedone reported 2 cases of osteonecrosis in 2.4 year follow up.

Favourable factors of healing in combined ipsilateral femoral neck with shaft fractures are minimal gap, stable fracture pattern and adequate vascularity at proximal femur fracture site [38]. Nonunion at neck site in these combined fractures is much less than in isolated neck fractures since most of the traumatic force is dissipated through shaft of femur.

In these high energy injuries, most of the energy is dissipated in femur shaft. Winquist grade 2, 3 and 4 type femoral shaft injuries are associated with severe soft tissue injuries. This forms the major cause of non-union in these winquist grades [38].

Tsai [68] reported one isolated neck nonunion in association with cut-out of proximal locked screws at 5 months and shaft nonunion due to distal locked screw breakage

at 7 months. There was no neck or shaft nonunion associated with screw cut off in our study.

Limitations of this study:

- small number of patients with limited statistical significance
- Follow up period was very short, long term complications like osteonecrosis and degenerative changes in articular surfaces require long term follow up.
- All available studies recommends early fixation of these fractures. There was an average time delay of 24 days in our study. Hence long term complications due to surgical delay > 21 days needs long term follow up of these patients. No study was available to provide details of complications due to surgical delay > 21 days.
- All cases of intramedullary nailing was done by open reduction to achieve anatomical reduction, because of difficulty in closed reduction and surgical delay. This is against the advantage of closed nailing technique reported in various studies.
- The choice of implant was chosen according to surgeon familiarity with chosen surgical technique and randomization. Hence it was not a randomized controlled study and there is an element of potential for bias.

Missed neck of femur fracture is a common complications reported in various studies in these type of bifocal injuries [86]. This is due to

- Diversion by other life threatening injuries.
- Head injured (unconscious/drowsy) patients cannot report pain
- In awake patients, hip pain might have been masked by pain due to shaft of femur fracture.
- Focus on shaft of femur injury and other associated fractures.

In our study there was no missed proximal femur fracture because of our routine radiological assay of pelvis with both hips.

Stable anatomical reduction of neck fractures is the key for union of neck of femur fractures in these bifocal injuries [72].

In intramedullary nailing group all cases received two proximal screws directing towards head region which provided rotational stability especially in case of neck of femur fracture. But in plating group all patients were fixed with dynamic hip screw only and anti-rotation screw was not used. But we got comparable outcomes with both the groups, probably due to delayed weight bearing.

All patients in our study are males. They fall into 3rd and 4th decade of life. This could be an important contribution for many of the good outcome in our study.

Recent studies and researches shows favourable outcomes following use of intramedullary nails for these type of combined fractures. Based on our study we consider the use of plate combinations do have a definitive role in managing these bifocal femur fractures.

In terms of average union time for both proximal femur and femoral shaft fractures, age of the patient, delay in surgery, duration of surgery, outcome results of both group showed no statistical significance.

Surgical technique is easy comparative to nailing in plate combinations group. Based on post-operative complications and comparatively less post-operative stiffness in both hip and knee joints in nailing group and use of single implant in addressing these bifocal fractures towards intramedullary nailing option.

Both of the surgical options for managing these bifocal injuries have achieved good and satisfactory functional outcome in our study. These results are comparable to the results given by similar comparative studies [70,71,72].

Conclusion

Our study achieved satisfactory functional outcome in treating ipsilateral proximal femur and shaft of femur fractures either with intramedullary nailing method (long Proximal femur nail, reconstruction nail) or various plate combinations method (DHS with long plate, DHS with compression plate in our study) with similar radiological and functional outcome.

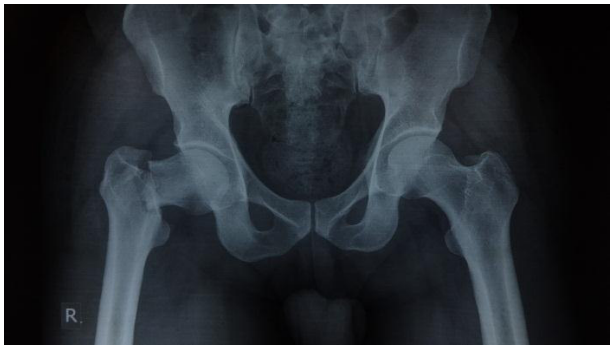
- There is no significant statistical difference in outcome among these two treatment options.
- In our study, road traffic accident forms the main mode of injury followed by fall from height
- Intramedullary nailing method has less blood loss and biological fixation of both fractures with a single implant. Also provides rotatory stability to proximal head fragment since two proximal screws are used but intra operative radiation exposure is more and achieving closed reduction requires technical expertise.
- Plate combinations method has the advantage of easiness in surgical technique and minimal radiation exposure but more soft tissue handling leading to more stiffness at both hip and knee joints compared to nailing group.

Case Illustrations

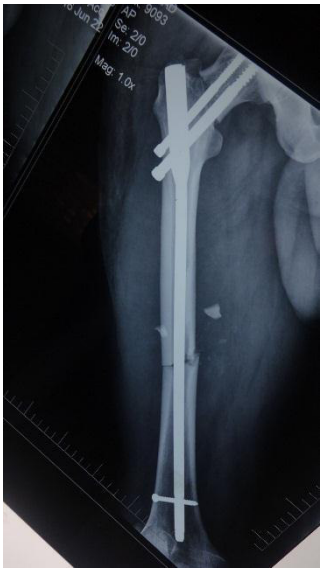
CASE 1 Mr. Subramani 55/M Ip No. 63460

Fall from height, displaced basicervical fracture, middle third shaft of femur fracture winquist grade 1. Patient was operated on 10th day. Surgery duration was 120 min. Procedure done- Long proximal femur nailing.

Pre op



Immediate post op



10 mon post op

Clinical picture

CASE 2 Mr. Mani 55y/M Ip no.112164

Road traffic accident, Basicervical fracture, displaced- neck of femur with middle third shaft of femur fracture, Winquist grade 1.

Pt was operated on 12th day. Duration of surgery-2 hrs. Implant exit had to be done after 1 year 6 months due to chronic discharging sinuses. Funtional outcome was good. There was no refracture after implant exit. Procedure done- Long proximal femur nailing.

Pre-Operative

Immediate Post - op

1 yr follow up

post implant exit

Clinical picture

CASE 3: Mr. Ananda Prasad 44/M IP.No. 105766

Road traffic accident, transcervical fracture displaced, middle third shaft of femur fracture winquist grade 2. Patient was operated on 47th day. Duration of surgery was 190 min. Patient had gone for infective non-union. Undergone implant exit and antibiotic coated nailing with excision arthroplasty after 1 year. Procedure done- Long proximal femur nailing.

Pre op

Immediate post op

Post implant exit and antibiotic coated nail with excision arthroplasty

Clinical picture

CASE 4 Mr. Baskar 24/M Ip no. 40344

Fall from height, displaced Transcervical fracture neck of femur, middle third shaft of femur winquist grade 2. Patient was operated on 21st day after trauma. Surgery duration was 150 min. Procedure done- Dynamic compression screw with plate and broad dynamic compression plate.

Pre op

Immediate post op

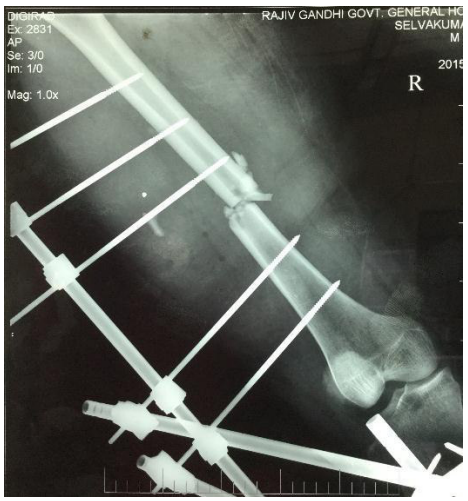
16 months post op

Clinical picture

CASE 5 Mr. Selvakumar 25y/M Ip no. 132367

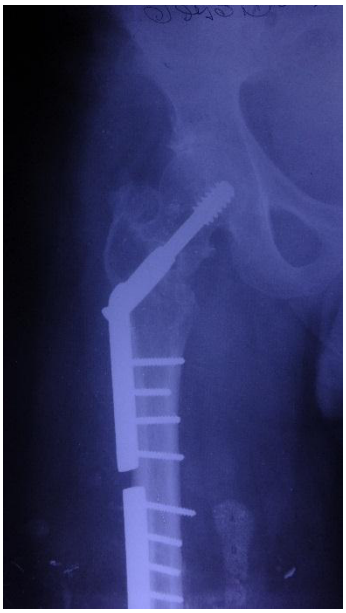
Road traffic accident, displaced basicervical fracture, middle third shaft of femur fracture, winquist grade 0. Initially managed with external fixator. Patient was operated for internal fixation 15 days after trauma. Surgery duration was 150 min. Procedure done- Dynamic compression screw with plate and broad dynamic compression plate. Patient has superficial infection which got healed. Associated fracture both bone leg was managed with LRS and split thickness skin grafting.

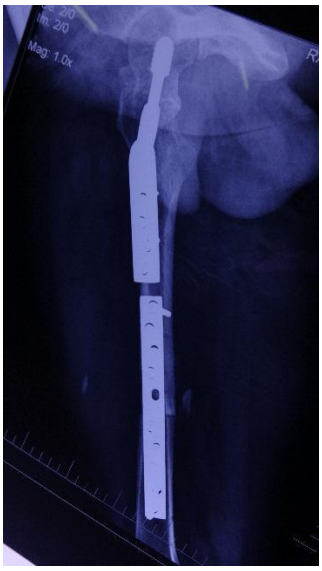
Pre op



Immediate post op

11 mon follow up





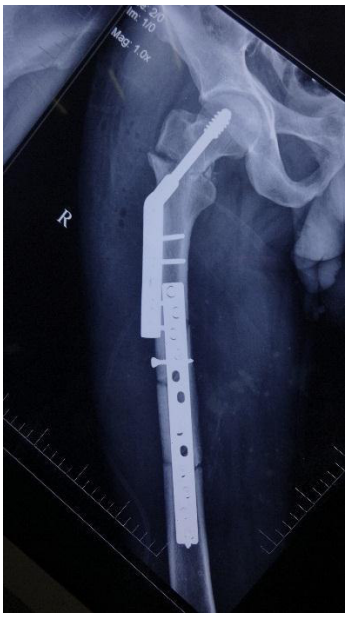
Clinical picture

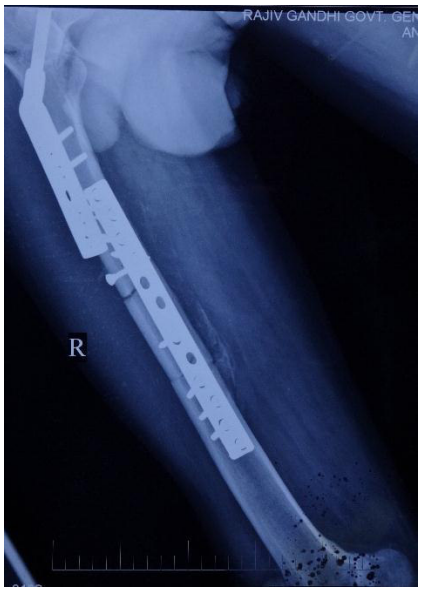
CASE 6 Mr. Anbazhagan 50/M Ip no. 22843

Road traffic accident, Displaced inter-trochanteric fracture, middle third segmental shaft of femur fracture. Patient was operated on 36th day after trauma. Surgery duration was 180 min. procedure done- Dynamic compression screw with plate and broad dynamic compression plating done. Shaft of femur gone for non-union which was bone grafted after 1 year.

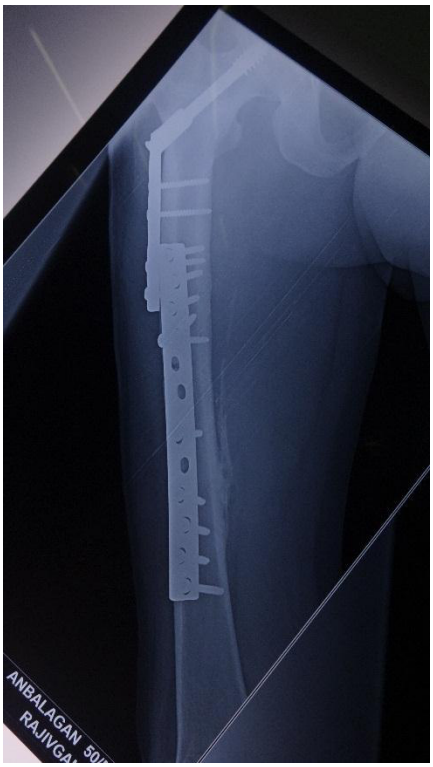
Pre op

Immediate post op





1 ½ year follow up



Clinical picture

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ANNEXURE

Annexure I

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013
Telephone No.044 25305301
Fax: 011 25363970

CERTIFICATE OF APPROVAL

To
Dr.S.Sivaraj
Post Graduate in M.S. (Orthopaedics)
Inst. of Orthopaedics & Traumatology
Madras Medical College
Chennai 600 003

Dear Dr.S.Sivaraj,

The Institutional Ethics Committee has considered your request and approved your study titled **"OUTCOME ANALYSIS IN IPSILATERAL PROXIMAL FEMUR AND FEMORAL SHAFT FRACTURES TREATED BY INTRAMEDULLARY NAIL AND PLATE COMBINATIONS – A COMPARATIVE STUDY "- NO. (II) 35032016.**

The following members of Ethics Committee were present in the meeting hold on **22.03.2016** conducted at Madras Medical College, Chennai 3

1.Dr.C.Rajendran, MD.,	:Chairperson
2.Dr.R.Vimala,MD.,Dean,MMC,Ch-3	:Deputy Chairperson
3.Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
4.Prof.P.Raghumani,MS, Dept.of Surgery,RGGGH,Ch-3	: Member
5.Dr.Baby Vasumathi, Director, Inst. of O&G,Ch-8	: Member
6.Prof.M.Saraswathi,MD.,Director, Inst.of Path,MMC,Ch-3	: Member
7.Prof.Srinivasagalu,Director,Inst.of Int.Med.,MMC,Ch-3	: Member
8.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person
9.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
10.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary – Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

Annexure II

CASE STUDY PROFORMA

1. General Data

    Name -

    Age /Sex –

    Occupation -

    Address -

    IP No: -

2. Chronological Data

    Date of injury -

    Date of Admission -

    Date of Surgery -

    Date of Discharge -

3. Mode of Injury

    RTA Fall Others

    Details of Injury -

4. Pre Existing systemic Illness -

5. Examination: –

    Side – Unilateral – Right Left Bilateral

    Type of Injury – Open/ Closed

Distal Neurovascular status

Associated Injuries

6. Radiographs –

Anatomical type for neck of femur fracture–

Whether displaced or undisplaced-

Winquist type for femoral shaft fracture-

7. Management-

Primary Management

Traction – Skin Skeletal

If open - Debridement -

Definitive Management

Procedure – Closed/ Open

Details of implant –

Nail - Length - Diameter -

Hip screw - Position - length -

Reduction –

Post-operative Management

- Antibiotics

- Suture removal

- Physiotherapy – Quadriceps strengthening exercises

- Hip / knee Bending exercises

Mobilization-

Non weight bearing -

Partial weight bearing -

Full weight bearing -

Postoperative Complications

Early complications –

- Infection – Superficial/ Deep -

- Wound gaping -

- Epidermal necrosis -

- Haematoma -

- Decubitus ulcer -

Late complications -

- Cutting out of screws -

- Z effect of screws -

- Reverse Z effect of screws -

- Varus collapse -

- Nail/plate breakage -

- Diaphyseal fracture -

- Limb length discrepancy -

- Hip stiffness/knee stiffness -

- Delayed union -

- Non-union :-

Secondary treatment if any

- Debridement

- Bone grafting

- Revision surgery

FOLLOW UP

1st FOLLOW UP

2nd FOLLOW UP

3rd FOLLOW UP

ASSESSMENT AT FINAL FOLLOW UP

Friedman and wyman score - _____

RESULT - _____

Annexure III

PATIENT CONSENT FORM

Study Title: **"Outcome analysis in ipsilateral Proximal Femur and Femoral shaft fractures treated by intramedullary nail and plate combinations – a comparative study".**

Study Center: **Institute of Orthopaedics and traumatology, Rajiv Gandhi Govt. General Hospital, Madras Medical College, Chennai - 3.**

Participant Name: Age/Sex: I.P.No. :

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the pitfall in the procedure. I have been explained about the safety, advantage and disadvantage of the technique.

I understood that my participation in the study is voluntary and that I am free to withdraw at anytime without giving any reason.

I understand that investigation, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to current study and any further research that may be conducted in relation to it, even if I withdraw from the study.

I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law.

I agree not to restrict the use of any data or results that arise from the study.

Date : **Signature / Thumb impression of Guardian**
Place :

Patient Name :

Signature of the investigator:

Name of the investigator: Dr. **Sivaraj.S**

ஆராய்ச்சி ஒப்புதல் கடிதம்

ஆராய்ச்சி தலைப்பு

தொடை எலும்பு முறிவு அறுவை சிகிச்சை
(நீண்ட ஆணி-Nail, அல்லது தகடு-Plate பொருத்துதல்) குறித்து ஆராய்ச்சி

ராஜீவ் காந்தி அரசு பொது மருத்துவமனைக்கு வரும் நோயாளிகளிடம் தொடை எலும்பு முறிவு அறுவை சிகிச்சை குறித்து ஆராய்ச்சி நடைபெறுகிறது.

பெயர்	:	தேதி	:
வயது	:	உள் நோயாளி எண்	:
பால்	:	ஆராய்ச்சி சேர்க்கை எண்	:

இந்த ஆராய்ச்சியின் விவரங்களும் அதன் நோக்கங்களும் முழுமையாக எனக்கு தெளிவாக விளக்கப்பட்டது.

எனக்கு விளக்கப்பட்ட விஷயங்களை நான் புரிந்துகொண்டு எனது சம்மதத்தை தெரிவிக்கிறேன்.

இந்த ஆராய்ச்சியில் பிறரின் நிர்பந்தமின்றி என் சொந்த விருப்பத்தின்பேரில் பங்கு பெறுகின்றேன். இந்த ஆராய்ச்சியில் இருந்து நான் எந்நேரமும் பின்வாங்கலாம் என்பதையும் அதனால் எந்த பாதிப்பும் ஏற்படாது என்பதையும் நான் புரிந்துகொண்டேன்.

நான் இந்த ஆராய்ச்சியின் விபரங்களைக் கொண்ட ஆராய்ச்சித் தகவல் தாளைப் பெற்றுக் கொண்டேன்.

இதன் மூலம் எந்த பின்விளைவும் ஏற்படாது என்று மருத்துவர் மூலம் தெரிந்து கொண்டு, நான் என்னுடைய சுய நினைவுடனும் மற்றும் முழு சுதந்திரத்துடனும் இந்த மருத்துவ ஆராய்ச்சியில் என்னை சேர்த்துக்கொள்ள சம்மதம் தெரிவிக்கிறேன்.

கையொப்பம்

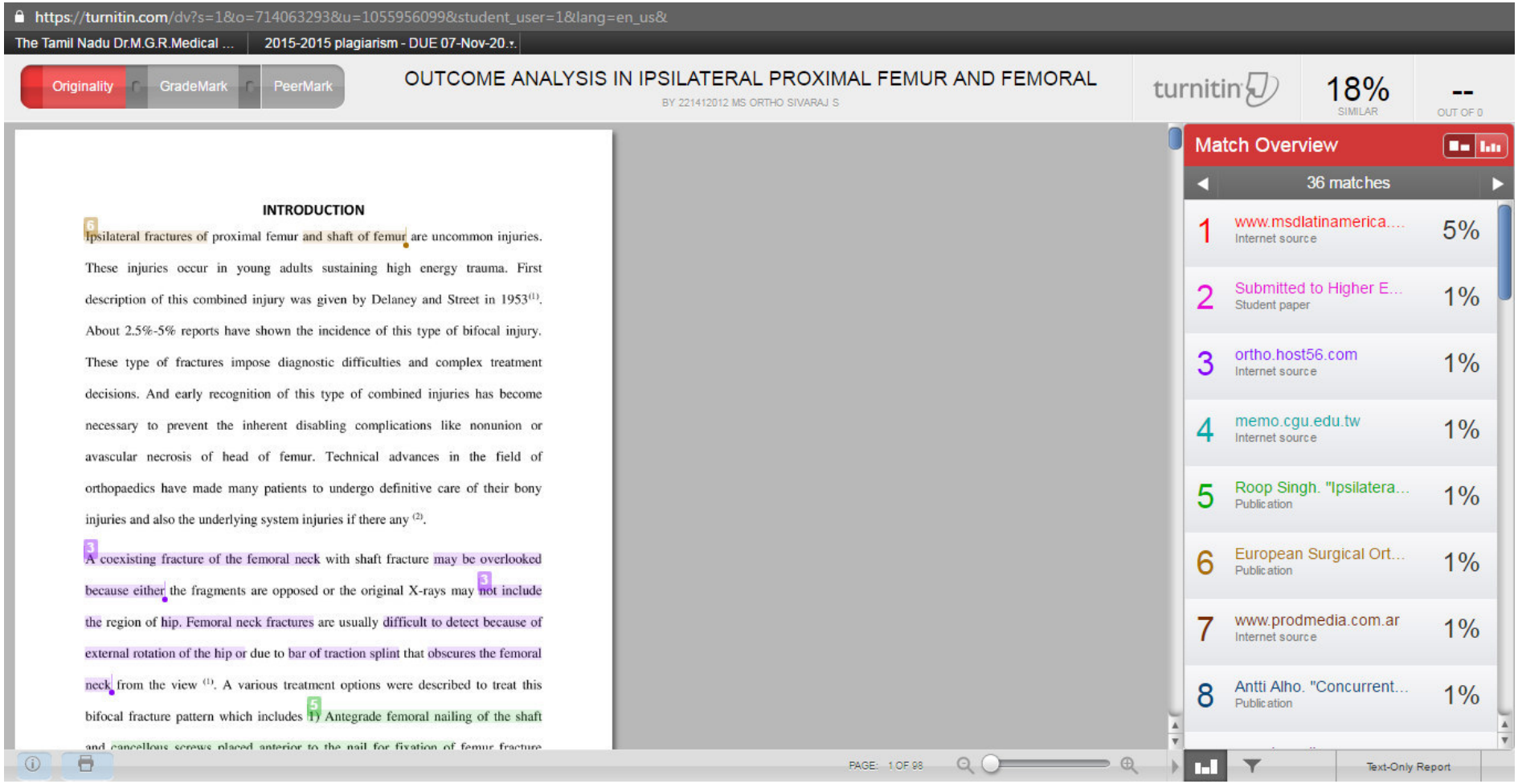
Annexure IV MASTER CHART FOR NAILING

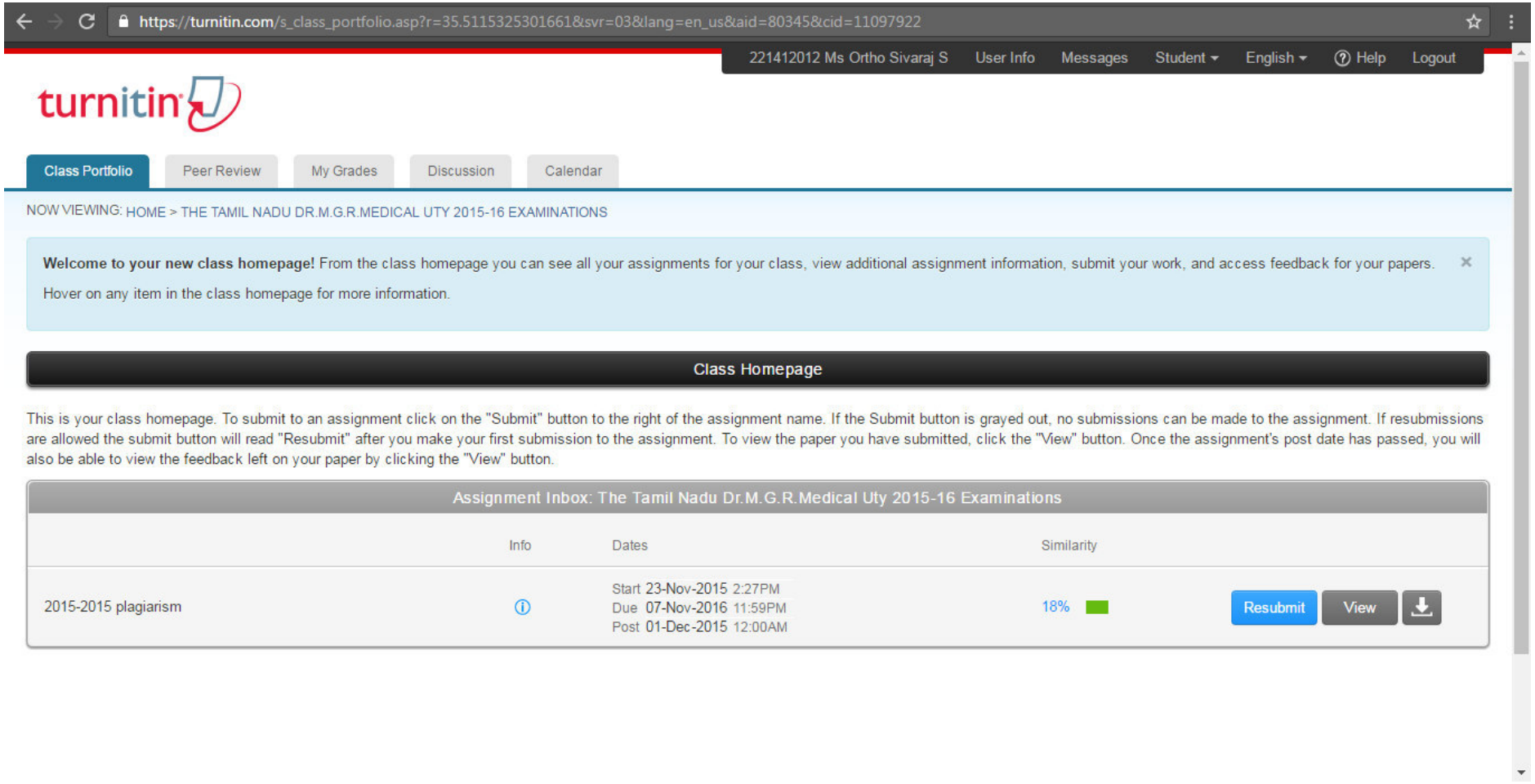
S. No.	Name and IP No.	Age in yrs	sex	side	Date of injury	Mode of injury	#NOF/ IT # with type	Femoral shaft # with Gr (winquist)	Associated injuries	Date of surgery	Time delay in days	procedure	Surgical time	Time of union	complications	Follow up	outcome
1.	Mr.Saminathan 37622	69	M	left	6.10.15	Fall from height	IT Dis 1	M/3 segmental	nil	15.10.15	9	Recon nail	120 min	IT 4 mon Shaft 9 mon	Trochanter malunion	11 mon	Fair
2.	Mr.Subramani 63460	55	M	right	11.11.16	Fall from height	BC Dis	M/3 1	Patella # left leg	22.11.16	10	Long PFN	120 min	Neck 4 mon Shaft 8 mon	Nil	10 mon	Good
3.	Mr.Mohan 22319	46	M	right	2.3.15	RTA	IT Dis 1	M/3 segmental	Head injury,shaft of humerus right	21.3.15	18	Long PFN	160 min	IT 3 mon Shaft 6 mon	Nil	1 ½ yr	Good
4.	Mr.Ananda Prasad 105766	44	M	Left	16.6.14	RTA	TC DIS	M/3 2	Head injury, Ipsilateral both bone leg	2.8.14	47	Long PFN	190 min	Infected non union	Infection ,implant exit and antibiotic nail with excision arthroplasty	2 yr	poor
5.	Mr.Veera raghavan 82115	52	M	Left	9.3.15	RTA	IT dis 1	M/3 2	Head injury, Pulmonary contusion	21.4.15	43	Long PFN	120 min	IT 3 mon Shaft 7 mon	nil	1 ½ yr	Good
6.	Mr.Mani 4949	26	M	right	28.5.15	RTA	BC Dis	M/3 2	Head injury, spr,ipr #	18.6.15	21	Long PFN	120 min	BC 4 mon shaft 8 mon	nil	1 yr	Good
7.	Mr.Mani 112164	55	M	left	25.11.14	RTA	TC Dis	M/3 1	nil	19.12.14	25	Long PFN	150 min	TC 6 mon shaft 10 mon	Infection, implant exit done	1 ½ yr	Fair
8.	Mr.Vijaya kumar 118523	37	M	right	3.11.15	RTA	IT Dis	M/3 0	Pulmonary contusion, rib # right side	18.11.15	15	Long PFN	150 min	IT 3 mon Shaft 6 mon	nil	10 mon	Good
9.	Mr.Natarajan 10470	74	M	left	3.11.16	RTA	IT Dis 1	M/3 0	Head injury, Fracture both bone left leg	15.11.16	12	Recon Nail	120 min	IT 3 mon Shaft 9 mon	nil	10 mon	Good
10	Mr.Vinoth kumar 51358	38	M	right	16.5.15	Fall from height	BC undisplaced	M/3 2	Head injury	5.6.15	20	Long PFN	150 min	BC 4 mon Shaft 9 mon	nil	1 yr	Good

MASTER CHART for Plate combinations

S. No.	Name and IP No.	Age in yrs	sex	side	Date of injury	Mode of injury	#NOF/ Trochanteric #	Femoral shaft # with Gr	Associated injuries	Date of surgery	Time delay in days	procedure	Surgical time	Time of union	complications	Follow up	outcome
1.	Mr.Baskar 40344	24	M	left	17.4.15	Fall from height	TC Dis	M/3 2	Patella # left	8.5.15	21	DHS with BDCP	150 min	TC 5 mon Shaft 9 mon	nil	1 yr 4 mon	Good
2.	Mr.Iyappan 61684	32	M	left	20.6.14	RTA	IT DIS	P/3 0	nil	23.7.14	32	DHS with long plate	140 min	IT 4 mon Shaft 10 mon	nil	1 yr	Good
3.	Mr.Jaya prakash 132252	42	M	left	27.12.14	RTA	IT Dis	M/3 0	Fracture both bone right leg	11.1.15	15	DHS with BDCP	180 min	IT 3 mon Shaft 9 mon	Superficial infection-healed	1 yr 10 mon	Good
4.	Mr.Prabhu 53964	32	M	left	22.5.15	RTA	IT Dis	M/3 0	Head injury Spr,ipr #	3.7.15	41	DHS with BDCP	120 min	IT 3 mon Shaft 8 mon	nil	1yr 3 mon	Good
5.	Mr.Prakasam 122527	45	M	right	2.12.14	RTA	IT undis	M/3 2	Pulmonary contusion,rib # multiple	8.1.15	36	DHS with long plate	170 min	IT 3 mon shaft 18 mon	Shaft non-union,bone grafting done	1 ½ yr	Fair
6.	Mr.Selvakumar 132367	25	M	right	13.10.15	RTA	BC Dis	M/3 0	Both bone right forearm Both bone right leg	17.10.15	15	DHS with BDCP	150 min	BC 4 mon Shaft 9 mon	Superficial infection-healed	11 mon	Fair
7.	Mr.Sridhar 36040	38	M	left	6.4.15	Fall from height	TC Dis	M/3 1	nil	29.4.15	23	DHS with long plate	170 min	TC 4 mon Shaft 7 mon	Nil	1yr 4 mon	Good
8.	Mr.Thaniga chalam 121172	40	M	right	10.11.15	Fall from height	IT Dis	M/3 2	nil	18.12.15	38	DHS with BDCP	160 min	IT 4 mon Shaft non united	Infected non union,implant exit and LRS done	9 mon	Poor
9.	Mr.Mahaboobsha 84563	52	M	right	12.7.15	RTA	IT undis	M/3 1	Shaft of right humerus #	25.7.15	13	DHS with BDCP	160 min	IT 3 mon Shaft 7 mon	nil	1 yr	Good
10	Mr.Anbazhagan 22843	50	M	left	3.3.15	RTA	IT Dis	M/3 segmental	Both bone left leg	9.4.15	36	DHS with BDCP	180 mn	IT 5 mon Shaft 15 mon	Shaft non union-bone grafting done	1 ½ yr	Fair

Annexure V Plagiarism

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INTRODUCTION

Ipsilateral fractures of proximal femur **and shaft of femur** [6]

are uncommon injuries. These injuries occur in young adults sustaining high energy trauma. First description of this combined injury was given by Delaney and Street in 1953(1). About 2.5%-5% reports have shown the incidence of this type of bifocal injury. These type of fractures impose diagnostic difficulties and complex treatment decisions. And early recognition of this type of combined injuries has become necessary to prevent the inherent disabling complications like nonunion or avascular necrosis of head of femur. Technical advances in the field of orthopaedics have made many patients to undergo definitive care of their bony injuries and also the underlying system injuries if there any (2).

A coexisting fracture of the femoral neck with shaft fracture **may be overlooked because either** [3]

the fragments are opposed or the original X-rays may

not include the region of **hip. Femoral neck fractures** are usually **difficult to detect because of external rotation of the hip or** due to **bar of traction splint** that **obscures the femoral neck** [3]

from the view (1). A various treatment options were described to treat this bifocal fracture pattern which includes

1) Antegrade femoral nailing of the shaft and **cancellous screws placed anterior to the nail for fixation of** femur fracture **neck.(** [5]

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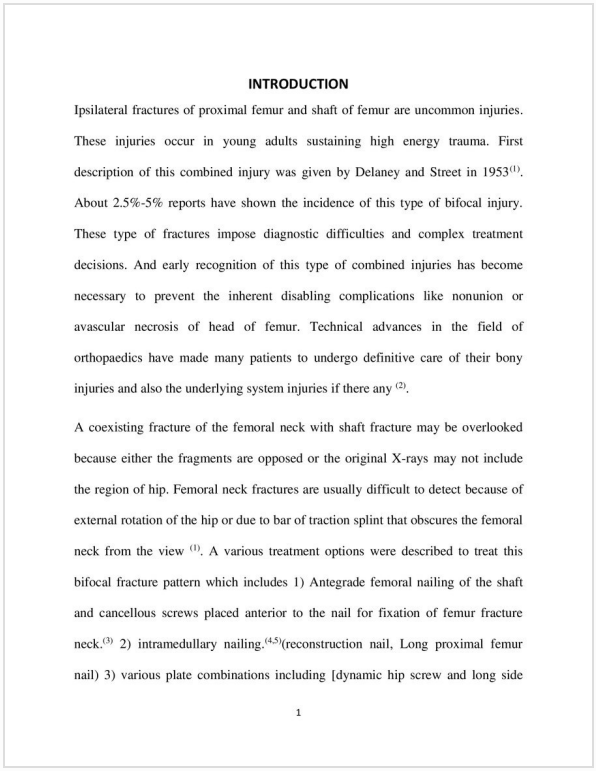

INTRODUCTION

Ipsilateral fractures of proximal femur and shaft of femur are uncommon injuries. These injuries occur in young adults sustaining high energy trauma. First description of this combined injury was given by Delaney and Street in 1953[1]. About 2.5%-5% reports have shown the incidence of this type of bifocal injury. These type of fractures impose diagnostic difficulties and complex treatment decisions. And early recognition of this type of combined injuries has become necessary to prevent the inherent disabling complications like nonunion or avascular necrosis of head of femur. Technical advances in the field of orthopaedics have made many patients to undergo definitive care of their bony injuries and also the underlying system injuries if there any [2].

A coexisting fracture of the femoral neck with shaft fracture may be overlooked because either the fragments are opposed or the original X-rays may not include the region of hip. Femoral neck fractures are usually difficult to detect because of external rotation of the hip or due to bar of traction splint that obscures the femoral neck from the view [1]. A various treatment options were described to treat this bifocal fracture pattern which includes 1) Antegrade femoral nailing of the shaft and cancellous screws placed anterior to the nail for fixation of femur fracture neck.[3] 2) intramedullary nailing.[4,5](reconstruction nail, Long proximal femur nail) 3) various plate combinations including [dynamic hip screw and long side

1